

# TRUCK SHOP MANUAL

## 1989

### VOLUME A

Volume 2 of 2

## LIGHT DUTY TRUCK

### E, F-150 through 350, F-Super Duty, Bronco

### BODY/CHASSIS/ELECTRICAL

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Ford Parts and Service Division  
Publications Department

## IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Shop Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

## NOTES, CAUTIONS, AND WARNINGS

As you read through the procedures, you will come across NOTES, CAUTIONS, and WARNINGS. Each one is there for a specific purpose. NOTES give you added information that will help you to complete a particular procedure. CAUTIONS are given to prevent you from making an error that could damage the vehicle. WARNINGS remind you to be especially careful in those areas where carelessness can cause personal injury. The following list contains some general WARNINGS that you should follow when you work on a vehicle.

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Be sure that the ignition switch is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on the vehicle. If you have an automatic transmission, set it in PARK unless instructed otherwise for a specific operation. If you have a manual transmission, it should be in REVERSE (engine OFF) or NEUTRAL (engine ON) unless instructed otherwise for a specific operation. Place wood blocks (4" x 4" or larger) to the front and rear surfaces of the tires to provide further restraint from inadvertent vehicle movement.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep yourself and your clothing away from moving parts, when the engine is running, especially the fan and belts.
- To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- Do not smoke while working on the vehicle.
- To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing before beginning to work on a vehicle. Tie long hair securely behind the head.
- Keep hands and other objects clear of the radiator fan blades. Electric cooling fans can start to operate at any time by an increase in underhood temperatures, even though the ignition is in the OFF position. Therefore, care should be taken to ensure that the electric cooling fan is completely disconnected when working under the hood.



Engine, Pre-Delivery, Maintenance and Lubrication service repairs are covered in the 1989 Light Truck Engine Manual, the 1989 Engine/Emissions Diagnosis Manual and the 1989 Truck Pre-Delivery Manual.

**Example:**

Brakes	Group 12	(2000)
General System Covered in Group	Group Number	Basic Part Number for Brake System Components

**Example:**

Suspension	Group 14	(3000	&	5000)
General System Covered in Group		Basic Part Number for Suspension Components		Basic Part Number for Exhaust Components

To aid in locating specific items in this manual, use the Alphabetical Subject Index in the back of the manual, or the Group and Section Index on the following pages.

Example: 11-02-21 = (Group) 11 — (Section) 02 — (Page) 21

The descriptions, testing procedures, and specifications in this manual were in effect at the time the manual was approved for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications, design or testing procedures without notice and without incurring obligation. Any reference to brand names in this manual is intended merely as an example of the types of tools, lubricants, materials, etc. recommended for use. Equivalents if available may be used. The right is reserved to make changes at any time without notice.



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# CHARGING SYSTEM

## GROUP 31

(10000)

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## SECTION 31-01 Charging System General Service

SUBJECT	PAGE	SUBJECT	PAGE
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### VEHICLE APPLICATION

All Light Truck Vehicles.

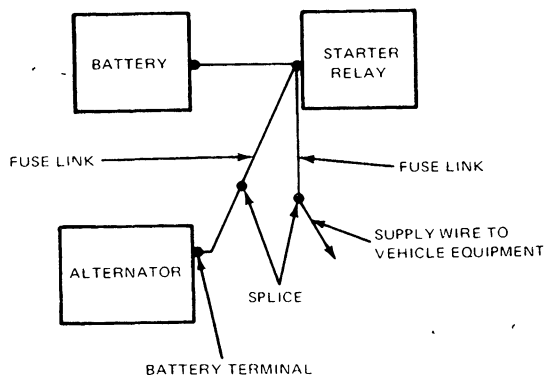
### DESCRIPTION AND OPERATION

The alternator charging system is a negative ground system, and consists of an alternator, regulator, charge indicator, storage battery, fuse link and associated wiring. Refer to the Electrical Vacuum and Troubleshooting Manual\* for schematics and locations of wiring harnesses.

\*Can be purchased as a separate item.

**DESCRIPTION AND OPERATION (Continued)****Fuse Link**

The fuse link used on the Bronco, E-150—E-350, Club Wagons and F-150—F-350 and F- Super Duty trucks, is a short length of insulated wire integral with the engine compartment wiring harness. It is several wire gauges smaller than the circuit that it protects and is the color of the circuit being supplied by the fuse link. Service fuse links are green or black depending on usage. All fuse links have a flag moulded on the wire or on the terminal insulator. Color identification of the flag or connector is Red—18 gauge wire, Orange—16 gauge wire, or Green—14 gauge wire. The illustration shows a typical fuse link installation.



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The fuse link is designed to burn out, thus protecting the alternator and wiring when heavy reverse current flows, such as when a booster battery is connected incorrectly, or a short to ground occurs in the wiring harness.

A burned out link may have bare wire ends protruding from the insulation, or expanded or bubbled insulation with illegible identification. If it is hard to determine if the link is burned out, perform a continuity test.

Refer to Section 34-31, Fuses, Circuit Breakers and Fuse Links, for testing procedures for fuse links used in the charging system.

**Preliminary Information**

Before performing charging or starting system tests on the vehicle, note the complaint such as: slow cranking, battery dead or using an excessive amount of water, top of battery wet, ammeter shows charge at all times or no charge, alternator warning lamp does not come on or never goes out. This information will aid in isolating the part of the system causing the symptom.

Next, visually inspect as follows:

1. Check the fuse link located between the starter relay and the alternator. Replace the fuse link if burned.
2. Check battery posts and battery cable terminals for clean and tight connections. Remove the battery cables (if corroded), clean and install them securely.
3. Check for clean and tight wiring connections at the alternator, regulator and engine.
4. Check the alternator belt tension. Tighten to specification, if necessary. Refer to Section 27-06, Accessory Drive Belts.
5. Discharged maintenance-free batteries could be caused by the following:
  - Glove compartment, hood, courtesy lamps or cargo lamp staying on because of misaligned or malfunctioning switches.
  - Pinched or grounded wire harness.

**DIAGNOSIS GUIDES**

Certain tests outlined in the Sections within this Group are illustrated in pictorial form. Schematic diagrams of the charging systems with either the warning lamp, ammeter (E-150-E-350) or voltmeter F-150-F-350, F-Super Duty and Bronco are listed under the appropriate alternator Section 31-10, Rear Terminal Alternator.

**Isolating the Problem**

Battery, starting system, and lamp systems problems can be caused by poor charging system performance. It is also possible to suspect the charging system because of an overload in another area of the electrical system.

To avoid guesswork, it is necessary to isolate the battery, the charging system, and the electrical circuits to correctly identify the area where the difficulty lies. Check the battery first before any electrical system diagnosis. The battery must be in proper state of charge. The battery must be operating properly before the other areas of the electrical system can perform normally.

**DIAGNOSIS GUIDES (Continued)****Battery Check**

Check battery to see if it has the capacity and ability to accept and hold a charge. Refer to Section 31-02, Batteries. If the battery is good, then the charging system should be checked to see that it performs its function of keeping the battery charged.

The battery capacity, specific gravity and cell comparison test (non-maintenance free batteries only) will determine the ability of a battery to accept

and hold a charge. If the battery cannot meet the specifications, replace it with a new fully charged battery before further diagnosis of other areas of the electrical system.

If the battery is found to meet the required specifications, it should be fully charged before proceeding with the diagnosis of other electrical system components.

**Charging System Check**

The General Charging System Test should be performed before testing any of the individual charging system components. The component tests will determine the type of component service to be performed.

The test instruments used in the General Charging System Test are a voltmeter (0-20 or 0-30 volt scale) and an ohmmeter. Special care should be given when using the ohmmeter near "hot" circuits. The component to be checked should be disconnected from the circuit or the battery terminals should be disconnected.

**CAUTION: Damage to the component could occur if the circuit is allowed to remain intact. A Charging System Analyzer Rotunda Model 059-00002 or equivalent is available for testing the charging system. Test instructions are provided with the analyzer.**

Continue through the Diagnosis Guides until a repair has been made. Then, again test the system to see if the repair has corrected the system problem.



## DIAGNOSIS GUIDES (Continued)



## CHARGING SYSTEM DIAGNOSIS

CONDITION	POSSIBLE CAUSE	RESOLUTION
Battery does not stay charged — engine starts OK	<ol style="list-style-type: none"> <li>1. Battery</li> <li>2. Loose or worn alternator belt</li> <li>3. Damaged or worn wiring or cables</li> <li>4. Alternator</li> <li>5. Regulator</li> <li>6. Other vehicle electrical systems</li> </ol>	<ol style="list-style-type: none"> <li>1. Test battery; replace if necessary (2).</li> <li>2. Adjust or replace belt (1).</li> <li>3. Service as required.</li> <li>4. Test and/or replace components as required (3).</li> <li>5. Test; replace if necessary (4).</li> <li>6. Check other systems for current draw. Service as required (1).</li> </ol>
Alternator noisy	<ol style="list-style-type: none"> <li>1. Loose or worn alternator belt</li> <li>2. Bent pulley flanges</li> <li>3. Alternator</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust tension or replace belt (1).</li> <li>2. Replace pulley (3).</li> <li>3. Service or replace alternator (3).</li> </ol>
Lamps and/or fuses burn out frequently	<ol style="list-style-type: none"> <li>1. Damaged or worn wiring</li> <li>2. Alternator regulator</li> <li>3. Battery</li> </ol>	<ol style="list-style-type: none"> <li>1. Service as required (1).</li> <li>2. Test, service, replace if necessary (4).</li> <li>3. Test, replace if necessary.</li> </ol>
Charge indicator lamp flickers after engine starts or comes on while vehicle is being driven	<ol style="list-style-type: none"> <li>1. Loose or worn alternator belt</li> <li>2. Alternator</li> <li>3. Field circuit ground</li> <li>4. Regulator</li> <li>5. Lamp circuit wiring and connector</li> <li>6. Operation at low engine speed (IDLE) and high vehicle electrical loads. (IAR ONLY)</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust tension or replace (1).</li> <li>2. Service or replace (3).</li> <li>3. Repair or replace wiring.</li> <li>4. Test, replace if necessary (4).</li> <li>5. Service as required.</li> <li>6. Test, replace if necessary (1). (IAR ONLY)</li> </ol>
Charge indicator lamp flickers while vehicle is being driven	<ol style="list-style-type: none"> <li>1. Loose or worn alternator belt</li> <li>2. Loose or improper wiring connections</li> <li>3. Alternator</li> <li>4. Regulator</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust tension, replace belt (1).</li> <li>2. Service as required (1).</li> <li>3. Service or replace (3).</li> <li>4. Test, replace if necessary.</li> </ol>
Charge indicator gauge shows discharge (Ammeter E-Series only) Voltmeter in the red area on F-Series and Bronco	<ol style="list-style-type: none"> <li>1. Loose or worn alternator belt</li> <li>2. Damaged or worn wiring (battery to alternator for ground or open)</li> <li>3. Field circuit ground</li> <li>4. Alternator</li> <li>5. Regulator</li> <li>6. Charge indicator gauge wiring and connections</li> <li>7. Damaged or worn gauge</li> <li>8. Other vehicle electrical system malfunction</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust tension or replace belt (1).</li> <li>2. Service or replace wiring.</li> <li>3. Repair or replace wiring.</li> <li>4. Service or replace (3).</li> <li>5. Test, replace if necessary (4).</li> <li>6. Service as required (1).</li> <li>7. Replace gauge (1).</li> <li>8. Service as required.</li> </ol>
<ol style="list-style-type: none"> <li>(1) Refer to test in this Section.</li> <li>(2) Refer to Battery Section (Section 31-02).</li> <li>(3) Refer to Appropriate Alternator Section.</li> <li>(4) Refer to Alternator Electronic Regulator Section (Section 31-43).</li> </ol>		

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## DIAGNOSIS GUIDES (Continued)





## CHARGING SYSTEM TEST — WITH EXTERNAL VOLTAGE REGULATOR (EVR)

TEST STEP		RESULT	ACTION TO TAKE
A1	PRELIMINARY CHECKS		
Check the following: <ul style="list-style-type: none"><li>● Fuse link.</li><li>● Battery terminals and cable clamps.</li><li>● Wiring connections at alternator, electronic voltage regulator (EVR) and engine-to-body grounds.</li><li>● Alternator belt tension.</li></ul>		<div> ➤ GO to A2.</div> <div> ➤ SERVICE and/or REPLACE as necessary. GO to A2.</div>	
A2	BASE VOLTAGE AND NO-LOAD TEST		
<ul style="list-style-type: none"><li>● Connect voltmeter to battery posts. Record battery voltage — this is base voltage.</li><li>● Start engine and run at 1500 RPM with no electrical load. Voltage should increase, but not more than 2.0 volts.</li></ul>		<div>Increased, but not more than 2.0 volts ➤ GO to A3.</div> <div>No increase ➤ GO to A6.</div> <div>Increases more than 2.0 volts ➤ GO to A14.</div>	
A3	LOAD TEST		
<ul style="list-style-type: none"><li>● Increases engine speed to 2000 RPM.</li><li>● Turn heater/A/C blower and headlamps on High.</li><li>● Voltage should read a minimum of 0.5 volt over base voltage.</li></ul>		<div>Increases .05 volt or more ➤ GO to A4.</div> <div>Increases .05 volt or more, but alternator indicator lamp stays On ➤ GO to A12.</div> <div>Increases less than 0.5 volt ➤ GO to A6.</div>	
A4	BATTERY DRAIN TEST — KEY OFF		
<ul style="list-style-type: none"><li>● Perform battery drain test as described in this section.</li></ul>		<div>Battery drain ➤ GO to A5.</div> <div>No battery drain ➤ REFER to Section 31-02.</div>	
A5	EVR DRAIN TEST		
<ul style="list-style-type: none"><li>● Remove connector from EVR.</li><li>● Perform battery drain test as described in this section.</li></ul>		<div>Battery drain ➤ CHECK other vehicle circuits for drain.</div> <div>No battery drain ➤ REPLACE EVR.</div>	
A6	UNDER VOLTAGE TEST		
<ul style="list-style-type: none"><li>● Disconnect EVR.</li><li>● Measure resistance between F terminal of EVR harness connector and ground.</li><li>● Resistance should be more than 3.0 ohms.</li></ul>		<div>Less than 3.0 ohms ➤ SERVICE grounded field circuit. CHECK wiring and alternator. GO to A2.</div> <div>More than 3.0 ohms. ➤ GO to A7.</div>	

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## DIAGNOSIS GUIDES (Continued)

## CHARGING SYSTEM TEST — WITH EXTERNAL VOLTAGE REGULATOR (EVR)

TEST STEP		RESULT	ACTION TO TAKE
<b>A7</b>	<b>JUMPER TERMINALS A TO F</b>		
<ul style="list-style-type: none"> <li>• Jumper A to F terminal at EVR connector.</li> <li>• Voltage should read a minimum of 0.5 volts over base voltage, with load test conditions in effect.</li> </ul>		Less than 0.5 volt	GO to <b>A8</b> .
		0.5 volt or more vehicles with alternator warning lamp	GO to <b>A10</b> .
		0.5 volt or more vehicles with ammeter	GO to <b>A11</b> .
<b>A8</b>	<b>JUMPER BAT TO FLD TERMINALS</b>		
<ul style="list-style-type: none"> <li>• Remove jumper from A to F terminals, but leave EVR disconnected.</li> <li>• Jumper BAT to FLD terminals at alternator.</li> <li>• Voltage should read a minimum of 0.5 volt over base voltage, with load test conditions in effect.</li> </ul>		0.5 volt or more	SERVICE faulty or worn A or F circuits. GO to <b>A2</b> .
		Less than 0.5 volt	GO to <b>A9</b> .
<b>A9</b>	<b>CHECK ALTERNATOR OUTPUT</b>		
<ul style="list-style-type: none"> <li>• Stop Engine.</li> <li>• Move voltmeter positive lead to BAT terminal of alternator.</li> </ul>		Base voltage	SERVICE or REPLACE alternator. GO to <b>A2</b> .
		Zero voltage	SERVICE or REPLACE circuit from alternator to battery. GO to <b>A2</b> .
<b>A10</b>	<b>CHECK FOR POWER AT S AND I TERMINALS</b>		
<p><b>NOTE: This test is only for vehicles equipped with indicator lamps.</b></p> <ul style="list-style-type: none"> <li>• Turn Off all load.</li> <li>• With engine at idle and jumper on terminals A and F, check for power at the S and I terminals at the EVR connector.</li> <li>• Voltage at the S terminal should be approximately 1/2 of voltage at the I terminal.</li> </ul>		 (No OK symbol)	SERVICE faulty S and/or I circuits as necessary. GO to <b>A2</b> .
		 (OK symbol)	REPLACE EVR. GO to <b>A2</b> .
<b>A11</b>	<b>CHECK FOR POWER TO S TERMINAL</b>		
<p><b>NOTE: This test is only for vehicles equipped with ammeters.</b></p> <ul style="list-style-type: none"> <li>• Turn Off all load.</li> <li>• Engine Off.</li> <li>• Ignition switch in RUN position.</li> <li>• Check for power to S terminal at EVR harness connector.</li> </ul>		 (No OK symbol)	SERVICE faulty S circuit as necessary. GO to <b>A2</b> .
		 (OK symbol)	REPLACE EVR. GO to <b>A2</b> .

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## DIAGNOSIS GUIDES (Continued)

## CHARGING SYSTEM TEST — WITH EXTERNAL VOLTAGE REGULATOR (EVR)

TEST STEP		RESULT	ACTION TO TAKE
A12	S CIRCUIT TEST		
<ul style="list-style-type: none"><li>● Engine at idle</li><li>● Check for power at S terminal on EVR connector</li><li>● Voltage should be approximately 1/2 of base voltage at BAT terminal.</li></ul>		<div>OK▶</div> <div>No voltage▶</div>	<div>REPLACE EVR. REPEAT Test Step A12.</div> <div>GO to A13.</div>
A13	ALTERNATOR STATOR VOLTAGE TEST		
<ul style="list-style-type: none"><li>● Engine at idle</li><li>● Check voltage at alternator S terminal.</li><li>● Voltage should be approximately 1/2 of base voltage at BAT terminal.</li></ul>		<div>OK▶</div> <div><del>OK</del>▶</div>	<div>SERVICE S circuit between alternator and EVR</div> <div>SERVICE or REPLACE alternator. GO to A12</div>
A14	OVER VOLTAGE TEST		
<ul style="list-style-type: none"><li>● Connect jumper between EVR and ground.</li></ul>		<div>Over voltage DOES go away▶</div> <div>Over voltage DOES NOT go away▶</div>	<div>SERVICE EVR ground GO to A2.</div> <div>GO to A15.</div>
A15	DISCONNECT EVR		
<ul style="list-style-type: none"><li>● Disconnect EVR.</li><li>● Over voltage should go away.</li></ul>		<div>OK▶</div> <div><del>OK</del>▶</div>	<div>REPLACE EVR. GO to A2.</div> <div>SERVICE shorted harness between EVR and alternator. GO to A2.</div>

CJ3577-2B

## DIAGNOSIS GUIDES (Continued)



















## CHARGING SYSTEM TEST — IAR ALTERNATOR

TEST STEP		RESULT	ACTION TO TAKE
<b>B1</b>	<b>PRELIMINARY CHECKS</b>		
	Preliminary Checks — <ul style="list-style-type: none"> <li>● Fuse Link</li> <li>● Battery Terminals and Cable Clamps</li> <li>● Wiring and Ground Connections to Alternator Regulator and Engine</li> <li>● Alternator Belt Tension</li> </ul>	(OK) ► (X) ►	GO to <b>B2</b> . SERVICE and/or REPLACE as necessary. GO to <b>B2</b> .
<b>B2</b>	<b>BASE VOLTAGE AND NO LOAD TEST</b>		
	<ul style="list-style-type: none"> <li>● Connect voltmeter to battery posts. Read battery voltage — this is base reading</li> <li>● Start engine, run at 1500 rpm with no electrical load. Voltage should increase but not more than 2.0 volts.</li> </ul>	Increases, but not more than 2.0 volts ► No increase ► Increase more than 2.0 volts ►	GO to <b>B3</b> . GO to <b>B5</b> . GO to <b>B12</b> .
<b>B3</b>	<b>LOAD TEST</b>		
	<ul style="list-style-type: none"> <li>● Increase engine speed to 2000 rpm.</li> <li>● Turn heater A/C, blower on high and headlamps on high beam.</li> <li>● Voltage should read a minimum of 1/2 volt over base voltage.</li> </ul>	Increases 1/2 volt or more ► Increases less than 1/2 volt ►	GO to <b>B4</b> . GO to <b>B5</b> .
<b>B4</b>	<b>BATTERY DRAIN TEST — KEY OFF</b>		
	<ul style="list-style-type: none"> <li>● Problem can still be battery drain. Turn OFF ignition, install test lamp in series with positive battery cable and check to isolate problem circuit.</li> </ul>	Battery drain ► No battery drain ►	CHECK vehicle circuits for drain. REFER to Section 31-02.
<b>B5</b>	<b>UNDER VOLTAGE TEST</b>		
	<ul style="list-style-type: none"> <li>● Disconnect regulator.</li> <li>● Check resistance between regulator A and F terminals.</li> <li>● Resistance should be more than 2.4 ohms.</li> </ul>	2.4 ohms or less ► More than 2.4 ohms ►	CHECK alternator for shorted field circuit and service if required. REPLACE regulator — GO to <b>B2</b> . GO to <b>B6</b> .
<b>B6</b>	<b>A TERMINAL VOLTAGE CHECK</b>		
	<ul style="list-style-type: none"> <li>● Connect regulator.</li> <li>● Measure A terminal voltage.</li> </ul>	No voltage ► Battery voltage ►	SERVICE A circuit wiring. GO to <b>B7</b> .

CJ3578-2C

## DIAGNOSIS GUIDES (Continued)

## CHARGING SYSTEM TEST — IAR ALTERNATOR

TEST STEP		RESULT	ACTION TO TAKE
<b>B7</b>	<b>F TERMINAL VOLTAGE CHECK — IGNITION OFF</b>		
	<ul style="list-style-type: none"> <li>Measure regulator F terminal voltage with ignition OFF</li> </ul>	No voltage  Battery voltage 	SERVICE IAR for open or grounded field circuit GO to <b>B2</b> GO to <b>B8</b>
<b>B8</b>	<b>F TERMINAL VOLTAGE CHECK — IGNITION ON</b>		
	<ul style="list-style-type: none"> <li>Turn ignition to RUN position (engine not running)</li> <li>Measure regulator F terminal voltage</li> </ul>	More than 1 5 volts  1 5 volts or less 	GO to <b>B9</b> GO to <b>B10</b>
<b>B9</b>	<b>I CIRCUIT TESTS</b>		
	Perform I circuit tests	   	REPLACE regulator GO to <b>B2</b> SERVICE I circuit wiring GO to <b>B2</b>
<b>B10</b>	<b>JUMPERED LOAD TEST</b>		
	<ul style="list-style-type: none"> <li>Disconnect alternator plug</li> <li>Connect jumper wires between B+ blades and wiring plug</li> <li>Repeat load test measuring voltage to jumper wires from battery negative clamp</li> <li>Voltage should rise 1/2 volt or more</li> </ul>	Voltage rise 1/2 volt or more  Voltage rise less than 1/2 volt 	Service alternator to starter relay wiring GO to <b>B2</b> GO to <b>B11</b>
<b>B11</b>	<b>LOAD TEST REPEAT — F TERMINAL</b>		
	<ul style="list-style-type: none"> <li>Keep B+ jumper wires in place</li> <li>Connect another jumper wire from alternator rear housing to regulator F terminal</li> <li>Repeat load test measuring voltage at B+ jumper wires</li> <li>Voltage should rise 1 2 volt or more</li> </ul>	Voltage rise 1/2 volt or more  Voltage rise less than 1/2 volt 	REPLACE regulator GO to <b>B2</b> SERVICE alternator GO to <b>B2</b>
<b>B12</b>	<b>OVER VOLTAGE TEST</b>		
	<ul style="list-style-type: none"> <li>Turn ignition to RUN position (engine not running)</li> <li>Measure voltage at regulator A terminal and starter solenoid</li> <li>Voltage difference should be 1/2 volt or less</li> </ul>	Voltage difference 1/2 volt or less  Voltage difference more than 1/2 volt 	GO to <b>B13</b> SERVICE A circuit wiring GO to <b>B2</b>
<b>B13</b>	<b>REGULATOR GROUND CHECK</b>		
	Check for loose regulator ground screws	   	GO to <b>B14</b> SERVICE ground screws GO to <b>B2</b>

CJ3579-2B

## DIAGNOSIS GUIDES (Continued)

CHARGING SYSTEM TEST — IAR ALTERNATOR			
TEST STEP		RESULT	ACTION TO TAKE
<b>B14</b>	ENGINE GROUND CHECK		
	Check for bad engine ground	(OK) ➤ (X) ➤	GO to <b>B15</b> SERVICE engine ground. GO to <b>B2</b> .
<b>B15</b>	ALTERNATOR GROUND CHECK		
	Check alternator ground	(OK) ➤ (X) ➤	GO to <b>B16</b> SERVICE alternator ground GO to <b>B2</b> .
<b>B16</b>	REPEAT NO LOAD TEST		
	<ul style="list-style-type: none"> <li>Start engine, run at 1500 rpm with no electrical load</li> <li>Voltage should increase but not more than 2.0 volts</li> </ul>	Increases 2.0 volts or less ➤ Increases more than 2.0 volts ➤	GO to <b>B3</b> . GO to <b>B17</b> .
<b>B17</b>	A AND F VOLTAGE CHECKS		
	<ul style="list-style-type: none"> <li>Turn ignition OFF.</li> <li>Measure voltage at regulator A and F terminals.</li> <li>Terminal voltages should be the same — Battery voltage</li> </ul>	Battery voltage ➤ Different than battery voltage ➤	REPLACE regulator. GO to <b>B2</b> . SERVICE integral assembly for grounded field circuit or bad regulator. GO to <b>B2</b> .

CJ3580-2B

## DIAGNOSIS AND TESTING

A voltmeter (0 to 20 volt scale), ohmmeter, such as Rotunda Digital Volt Ohm Meter 007-00001, jumper wire and a test lamp (12 volt) are the only tools required to perform an accurate check of the complete charging system. Calibrate meters once a year and stamp the date of calibration on the meter face. It is recommended that this practice be followed by all technicians to maintain their meters at acceptable accuracy.

The tests are divided into On Vehicle and On Bench Test procedures. The On Bench Test procedures are described under the applicable

Component Section (31-02, Batteries—31-10, Rear Terminal Alternators, 31-43, Alternator Electronic Regulator).

Troubleshooting or diagnosis is required before actual service can be performed to the electrical system. Even where an obvious fault makes the replacement of a unit necessary, find out why the unit failed. Refer to the Diagnosis Guide in this Section. When a problem is diagnosed correctly, unnecessary service is prevented, the time the vehicle is out of operation will be decreased, and the service performed will be permanent.

## On Vehicle Tests

Before performing charging system tests on the vehicle, note the complaint such as: slow cranking, battery dead, top of battery wet, ammeter shows excessive charge at all times or no charge,

alternator warning lamp does not come on or never goes out. This information will aid in isolating the part of the system causing the symptom. (Refer to Section 31-02 for battery warnings and cautions.)

**DIAGNOSIS AND TESTING (Continued)****Visual Inspection**

1. Check the fuse link located between the starter relay and the alternator. If burned, determine cause, service system and replace fuse link.
2. The battery must be in proper state of charge (non-maintenance free battery—at least 1.200 specific gravity). Refer to Section 31-02, Batteries. Check the battery posts and battery cable terminals for clean and tight connections. Remove the battery cables (if corroded), clean and install them securely.
3. Check for clean and tight wiring connections at the alternator, regulator and engine.
4. Check the alternator belt tension and tighten to specification, if necessary. Refer to Section 27-06, Accessory Drive Belts.

**Fuse Link Continuity Check**

1. Make certain that the battery is OK, then turn on the headlamps or any other accessory. If the headlamps or accessory do not operate, the fuse link is probably burned out.
2. On some vehicles there are several fuse links. Use the same procedure as in Step 1 to test the fuse link that protects vehicle equipment.

To test the fuse link that protects the alternator make certain the battery is OK. Then check with a voltmeter for voltage at the BAT terminal of the alternator. No voltage indicates that the fuse link is probably burned out.

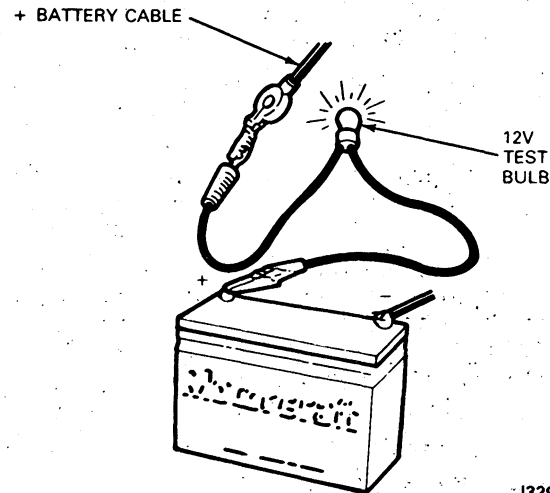
**Battery Drain Test**

1. Connect a 12-volt test lamp in-series between the battery positive cable clamp and the positive terminal of the battery. Test with all switches OFF. Do not be misled by clock-winding current. Touch cable clamp to terminal to wind clock.
2. If lamp glows, pull fuses, one at a time, and check each circuit for short. Service wiring harnesses or components as required.

**Constant Current Drain Test**

Use a regular 12-volt test lamp for this test:

1. Ensure all vehicle electrical circuits are turned off. To check for minimum battery charge and/or condition of bulb, connect test lamp across battery terminals. Lamp should light. Disconnect test lamp.
2. Disconnect either positive or negative battery cable. Connect 12-volt test lamp between cable terminal and battery post.



3. If lamp glows, connect terminal to post for five seconds then repeat to ensure results.

**Test Conclusions**

- Lamp Does Not Glow—No current drain.
- Lamp Does Glow—Check individual circuits to locate cause of current drain. Underhood lamp, glove compartment, cargo lamps, are prime suspects.

**Alternator Indicator Lamp Test****Normal Charge Indicator**

With ignition switch in the OFF position, charge indicator (alternator) lamp is off.

With ignition switch in RUN (engine not running), charge indicator (alternator) lamp is on.

With ignition switch in RUN (engine running), charge indicator (alternator) lamp is off.

1. If the charge indicator lamp does not light with the ignition key in the RUN position (engine not running), check the I wiring circuit (ignition switch to regulator I terminal), for an open circuit or burned out charge indicator lamp.
2. If the charge indicator lamp does not light, disconnect the wiring plug connector at the regulator and connect a jumper wire from the I terminal of the regulator wiring plug to the negative battery post cable clamp.
3. The charge indicator lamp should light with the ignition key turned to the RUN position.
4. If the charge indicator bulb does not light, check the bulb for continuity and replace if necessary.
5. If the bulb is not burned out, an open circuit exists between the ignition switch and the regulator.
6. Check the 500 ohm resistor across the charge indicator lamp. Vehicles equipped with an ammeter will not have a resistor.



**DIAGNOSIS AND TESTING (Continued)****Ammeter System Test****Normal Charge Indication**

With ignition switch in the OFF position and no electrical load, ammeter should show 0 on center scale.

With ignition in the RUN position (engine running) (fully charged battery), needle deflects towards charge and returns toward center scale in time.

With ignition switch in OFF position and headlamps on, ammeter should show discharge. If the ammeter does not register a discharge, check for loose connections at the ammeter, or an open circuit wire, prior to replacing the gauge.

**No Load Test**

1. Connect a tachometer to the engine.
2. Start the engine. Increase speed to approximately 1500 RPM. With no other electrical load (foot off brake pedal and doors closed), the voltmeter pointer should move upward (increase), but not more than 2.5 volts above the base voltage.

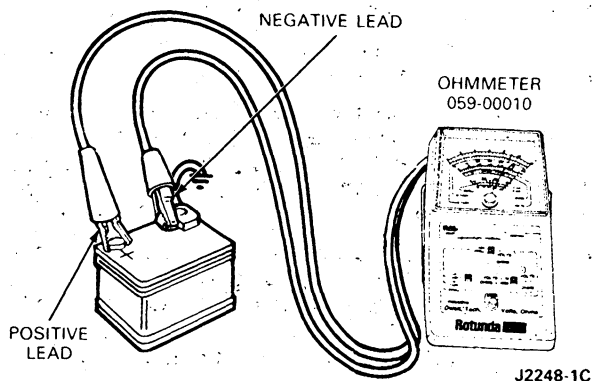
NOTE: The reading should be taken when the voltmeter pointer stops rising. It may take a few minutes to reach this point. If the voltage increases to proper level, perform Load Test. If the pointer continues to rise, perform the Over Voltage Tests. If the voltage does not rise to proper level, perform Under Voltage Tests.

**General Charging System Tests**

When performing charging system tests turn off all lamps and electrical components. Place the transmission in NEUTRAL and apply the parking brake.

**Base Voltage Test**

1. With ignition in OFF position and no electrical load connect the negative lead of the voltmeter to the negative battery cable clamp.
2. Connect the positive lead of the voltmeter to the positive battery cable clamp.
3. Record the battery voltage reading shown on the voltmeter scale. This reading is called the base voltage.

**Load Test**

1. With the engine running, turn the heater or air conditioner blower motor on (high speed) and headlamps on high beam.
2. Increase the engine speed to approximately 2000 RPM. The voltmeter should indicate a minimum of 0.5 volt above the base voltage. If not, perform the Under Voltage Test.

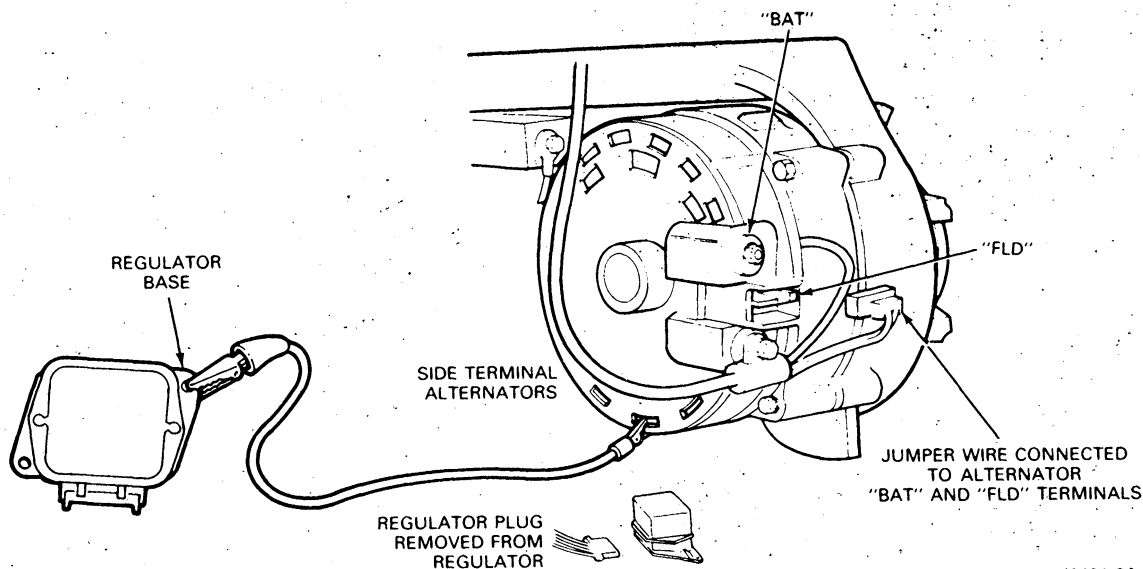
If the above tests indicate proper voltage readings, the charging system is operating normally. Proceed to the tests below if one or more of the readings is different than shown above and use a test lamp to check for battery drain.

**Over Voltage Tests**

These tests will help determine the cause of the charging system malfunction and will provide the technician with possible solutions to the problem.

**DIAGNOSIS AND TESTING (Continued)****EVR System**

1. If the voltmeter indicated more than 2.5 volts above base voltage in the No Load Test, connect a jumper wire between the regulator base and the alternator frame or housing. Repeat the No Load Test.



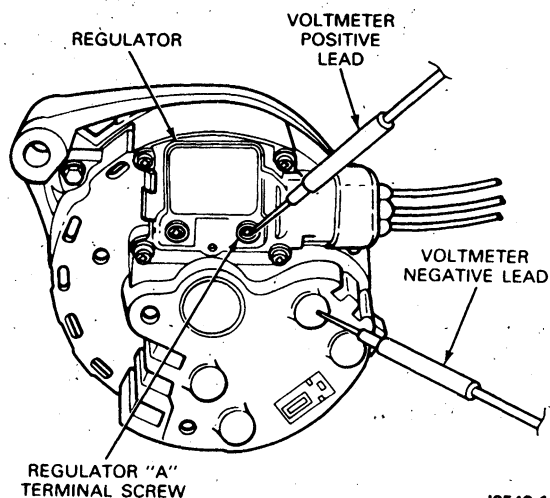
J3581-2A

2. If the over voltage condition disappears, check the ground connections on the alternator, regulator, and from the engine to the dash panel and the battery. Clean and tighten the connections securely.
3. If the over voltage condition still exists, disconnect the regulator wiring plug from the regulator and repeat the No Load Test.
4. If the over voltage condition disappears (voltmeter reads base voltage), replace the voltage regulator.
5. If over voltage still exists with the regulator wiring plug disconnected, check for a short between circuits A and F in the wiring harness and service as necessary. Then connect the regulator wiring plug to the regulator.

**IAR System**

If the voltmeter indicated more than 2.5 volts above base voltage in the No Load Test, follow these procedures:

1. With the ignition in the RUN position (engine not running), connect the voltmeter negative lead to the alternator rear housing. Contact the voltmeter positive lead first to the alternator output connection at the starter solenoid and then to the regulator A screw head.
2. If the voltage difference between the two locations is greater than 0.5 volts, service the A wiring circuit to eliminate the high resistance condition indicated by the excessive voltage drop.
3. If the over voltage condition still exists, check for loose regulator and alternator grounding screws. Tighten loose regulator grounding screws to 1.7-2.8 N·m (15-26 in-lb).



J3548-1A

## DIAGNOSIS AND TESTING (Continued)

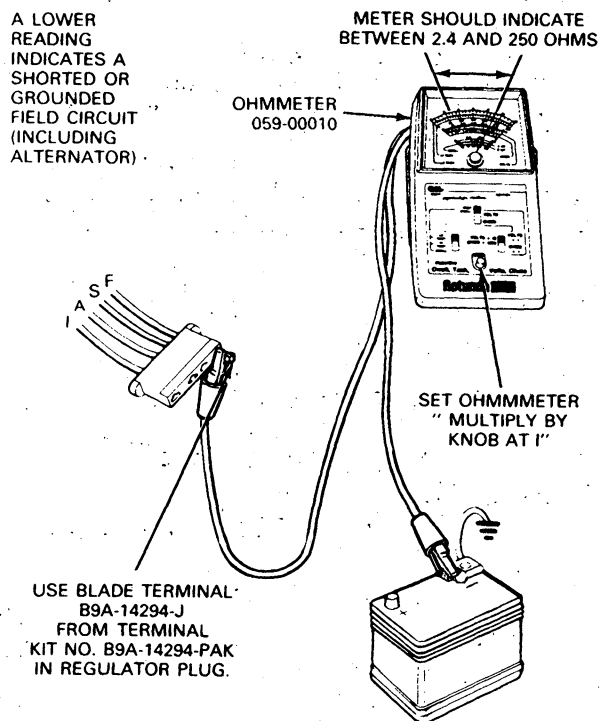
4. If the over voltage condition still exists, connect the voltmeter negative lead to the alternator rear housing. With the ignition OFF, contact the voltmeter positive lead first to the regulator A screw head and then to the regulator F screw head. Different voltage readings at the two screw heads indicate a malfunctioning regulator, grounded brush lead or a grounded rotor coil. Service the entire integral alternator/regulator assembly.
5. If the same voltage reading (battery voltage) is obtained at both screw heads, in Step 4 and there is no high resistance in the ground or at circuit, replace the regulator.

## Under Voltage Tests

## EVR System

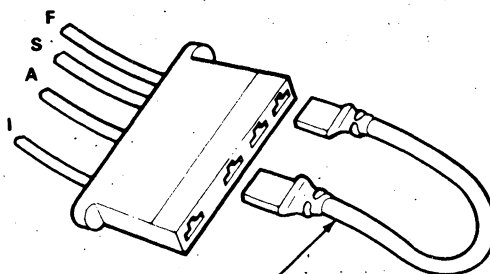
If the voltmeter did not indicate more than 0.5 volts above the base voltage, follow these procedures:

1. Disconnect the wiring plug from the regulator and connect an ohmmeter from the F terminal of the plug to a ground. The meter should read more than 2.4 ohms. If less than 2.4 ohms is indicated, service the grounded field circuit in the wiring harness or the alternator and then repeat the Load Test.



J1633-1J

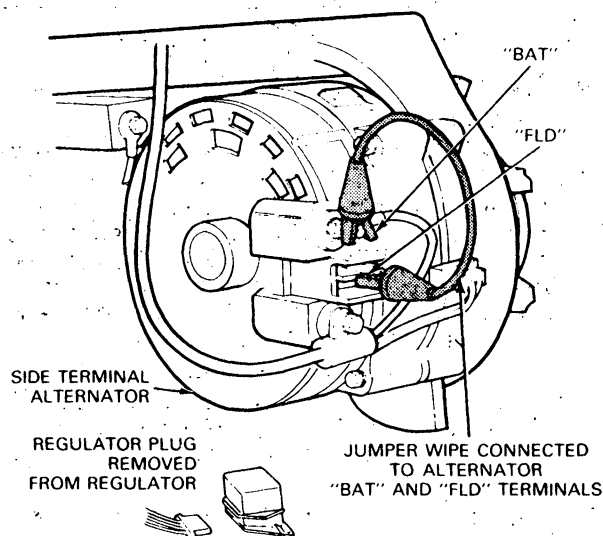
2. If the ohmmeter indicates more than 2.4 ohms, connect a jumper wire from the A to F terminals of the plug and repeat the Load Test. If the voltmeter now indicates more than 0.5 volts above base voltage, the regulator or wiring is damaged or worn. Perform S and I Circuit Tests and service wiring or regulator as required.



USE JUMPER WIRE  
TO CONNECT "A" AND "F" TERMINALS  
AT REGULATOR PLUG

J1635-1C

3. If the voltmeter still indicates a problem of under voltage, remove the jumper wire from the regulator plug and leave the plug disconnected from the regulator. Disconnect the FLD terminal on the alternator and pull back the protective cover from the BAT terminal. Then connect a jumper wire to the FLD and BAT terminals on the alternator and repeat the Load Test.



J3583-1A

**DIAGNOSIS AND TESTING (Continued)**

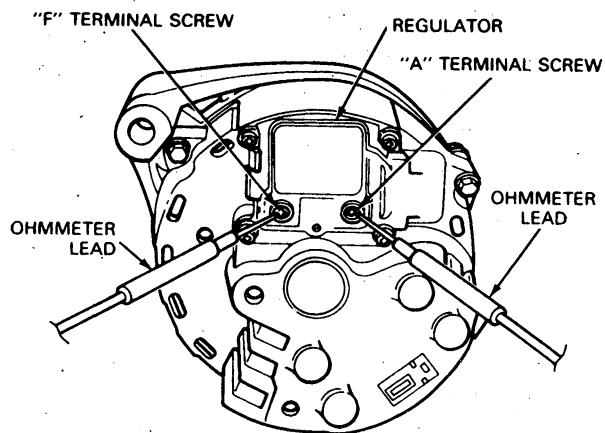
4. If the voltmeter now indicates a 0.5 volt or more increase above the base voltage, perform S and I Circuit Tests and service the wiring or regulator as indicated.
5. If the voltmeter still indicates under voltage, stop the engine and move the positive voltmeter lead to the BAT terminal of the alternator.

If the voltmeter now indicates base voltage, service the alternator. If the voltmeter indicates zero volts, service the alternator to starter relay wire (Circuit 38).

**IAR System**

If the voltmeter did not indicate more than 0.5 volts above the base voltage, follow these procedures:

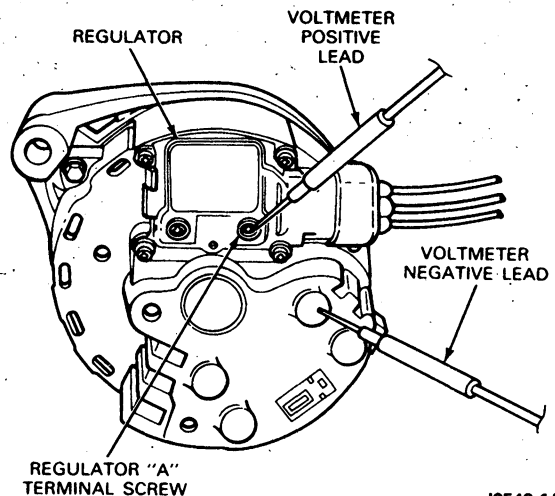
1. Disconnect the wiring plug from the regulator and connect an ohmmeter between the regulator A and F terminal screws. The meter should indicate more than 2.4 ohms. If less than 2.4 ohms is indicated, service the integral alternator/regulator unit for a failed regulator and check the alternator for a shorted rotor or field circuit. Perform the Load Test.



J3549-1A

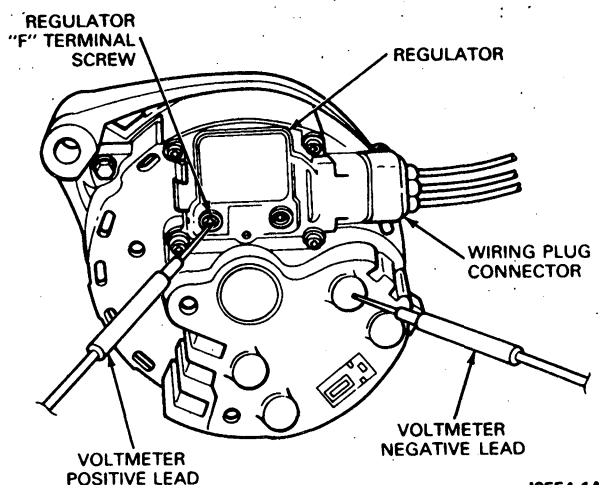
**CAUTION:** Do not replace the regulator before a shorted rotor coil or field circuit has been serviced. The result could be another damaged regulator.

2. If the above ohmmeter reading is greater than 2.4 ohms, reconnect the regulator wiring plug and connect the voltmeter negative lead to the alternator rear housing. Contact the voltmeter positive lead to the regulator A terminal screw. The meter should indicate battery voltage. If there is no voltage, service the A wiring circuit. Perform the Load Test after servicing.



J3548-1A

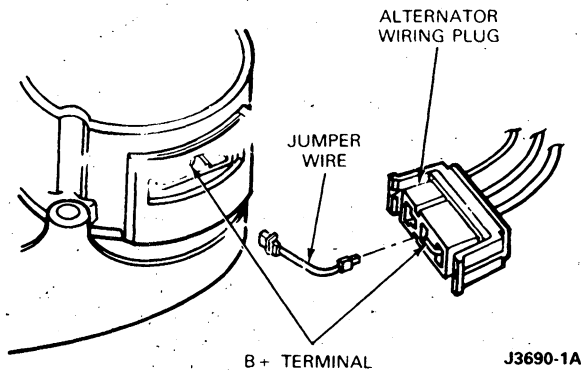
3. If voltmeter indicates battery voltage, connect voltmeter ground lead to alternator rear housing. With the ignition switch in OFF position, contact voltmeter positive lead to regulator F terminal screw. The meter should indicate battery voltage. If there is no voltage, service integral alternator/regulator unit for an open field circuit. Perform Load Test after servicing.



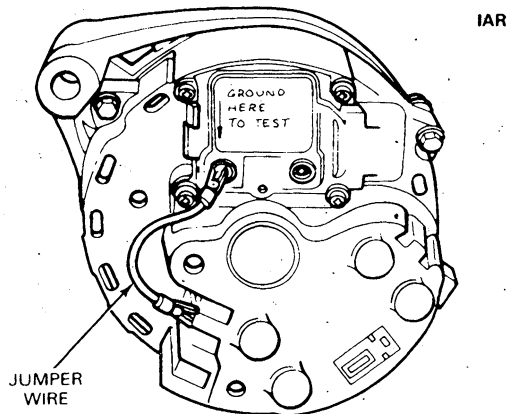
J3554-1A

**DIAGNOSIS AND TESTING (Continued)**

4. If voltmeter indicates battery voltage, connect voltmeter negative lead to alternator rear housing. Turn ignition switch to RUN (engine off) and contact voltmeter positive lead to regulator F terminal screw. Refer to illustration under Step 3. The voltmeter should indicate 1.5 volts or less. If more than 1.5 volts is indicated, perform I circuit tests and service I circuit if needed. If I circuit checks normal, replace regulator if needed and perform Load Test.
5. If 1.5 volts or less is indicated, disconnect alternator wiring plug and connect a set of 12-gauge jumper wires between alternator B(+) terminal blades and mating wiring connector terminals. Perform Load Test, but connect voltmeter positive to one of B(+) jumper wire terminals. If voltage rises more than 0.5 volt above base voltage, service alternator-to-starter relay wiring. Repeat Load Test, measuring voltage at battery cable clamps after servicing.



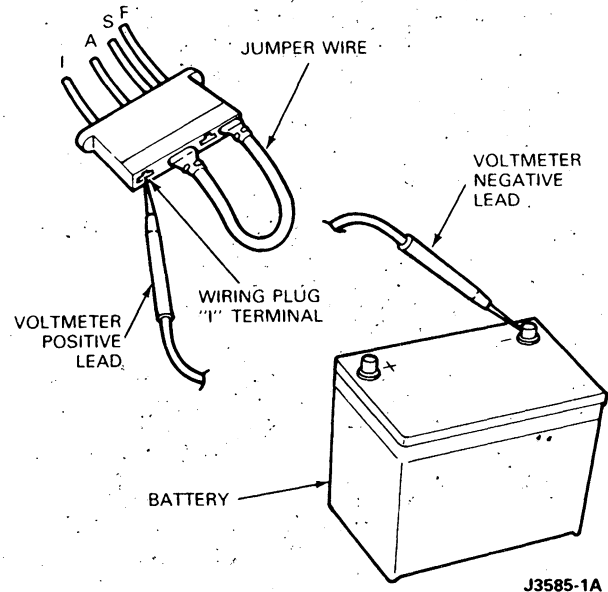
6. If voltage does not rise more than 0.5 volt above base voltage, connect a jumper wire from alternator rear housing to regulator F terminal. Repeat Load Test with voltmeter positive lead connected to one of B(+) jumper wire terminals. If voltage rises more than 0.5 volt, replace regulator.



7. If voltage does not rise more than 0.5 volt, service alternator. Refer to illustration under Indicator Lamp System Normal Charge Indication, IAR System.

**Regulator S and/or I Circuit Test****EVR System**

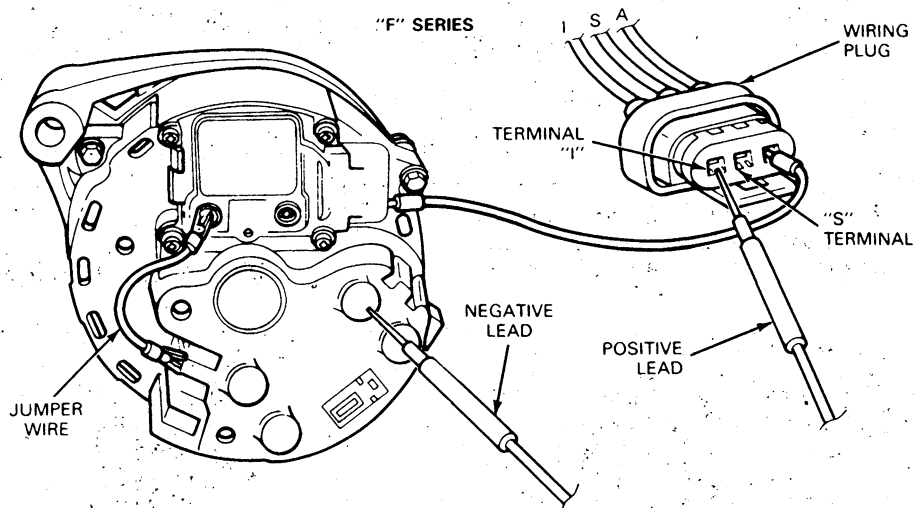
1. Disconnect the regulator wiring plug and install a jumper wire between the A and F terminals.
2. With the engine idling and the voltmeter negative lead connected to the battery ground terminal, connect the voltmeter positive lead to the S terminal and then to the I terminal of the regulator wiring plug. The voltage of the S circuit should read approximately one-half that of the I circuit. If voltage readings are normal, remove the jumper wire. Replace the regulator and connect the wiring plug. Repeat the Load Test.



3. If no voltage is present, service the faulty wiring circuit. Connect the voltmeter positive lead to the positive battery terminal.
4. Remove the jumper wire from the regulator wiring plug and connect the wiring plug to the regulator. Repeat the Load Test. Refer to illustration of jumper wire connections in Under Voltage, External Voltage Regulator System.

**DIAGNOSIS AND TESTING (Continued)****IAR System**

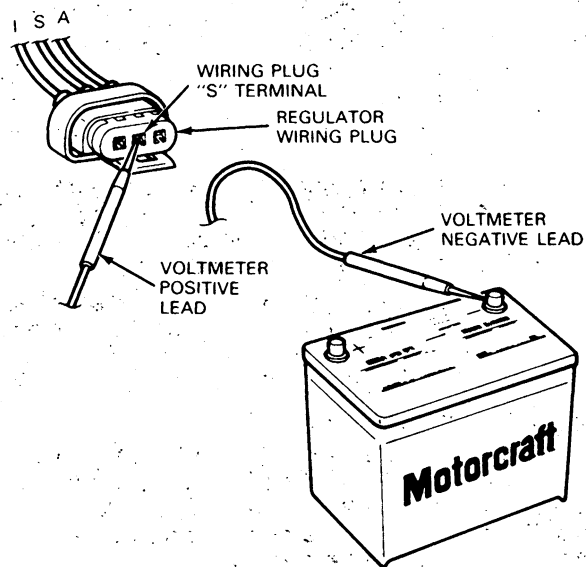
1. Disconnect the wiring plug from the regulator. Connect a jumper wire from the regulator "A" terminal to the wiring plug "A" lead. Add a jumper wire from the regulator "F" screw to the alternator rear housing.
2. With the engine idling and the voltmeter negative lead connected to the battery ground terminal, connect the voltmeter positive lead to the "S" terminal and then to the "I" terminal of the regulator wiring plug. The voltage at the "S" circuit should read approximately one-half that
3. of the "I" circuit. If voltage readings are normal, remove the jumper wires. Replace the regulator and connect the wiring plug to the regulator. Repeat the load test.
3. If no voltage is present, remove the jumper wires and service the faulty wiring circuit or alternator.
4. Connect the voltmeter positive lead to the positive battery terminal. Connect the wiring plug to the regulator. Repeat the load test.



J3586-2B

**S Circuit with Ammeter**

1. Disconnect the regulator wiring plug from the alternator regulator connector. Connect the positive lead of the voltmeter to the "S" terminal and the negative lead to the battery ground terminal voltage should not be indicated with ignition switch off.
2. Turn the ignition switch to RUN position (engine not running). The voltmeter should indicate battery voltage. If the voltage reading is normal, replace the regulator and repeat the load test.
3. If there is no voltage reading, service the S wire lead from the ignition switch to the regulator wiring plug.
4. Connect the positive voltmeter lead to the positive battery cable terminal, connect regulator wiring plug to regulator and repeat the Load Test.

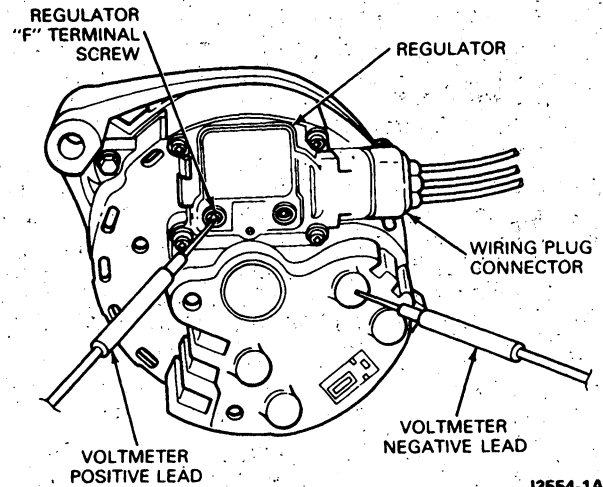


J3587-1A

**DIAGNOSIS AND TESTING (Continued)****Field Circuit Drain—Integral Alternator/Regulator****(IAR) System**

Connect the voltmeter negative lead to the alternator rear housing for all of the following voltage readings:

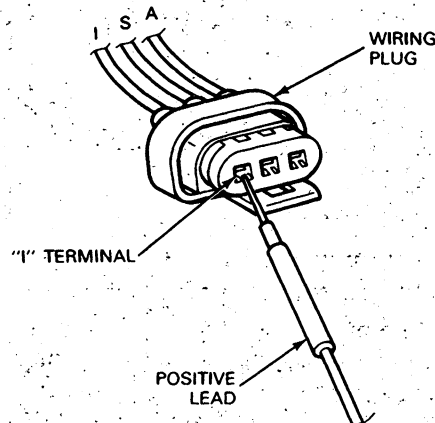
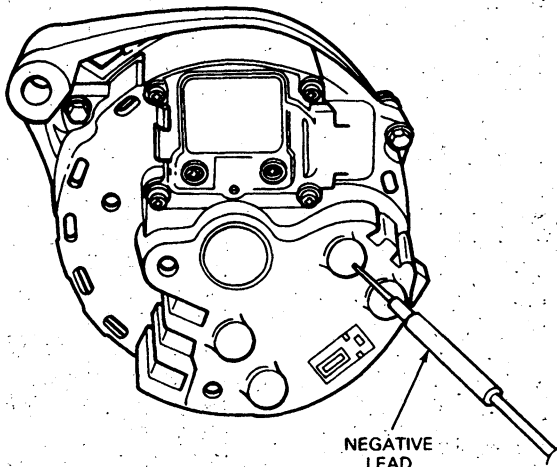
1. With the ignition switch turned OFF, contact the voltmeter positive lead to the regulator F terminal screw. The meter should indicate battery voltage if the system is operating normally. If less than battery voltage is indicated, proceed to Step 2 to find the cause of the current drain.



J3554-1A

2. Disconnect the wiring plug from the regulator and contact the voltmeter positive lead to the wiring plug I terminal. No voltage should be

indicated. If voltage is indicated, service the I lead from the ignition switch to identify and eliminate the voltage source.



J3555-2A

3. If no voltage was indicated in Step 2, contact the voltmeter positive lead to the wiring plug S terminal. No voltage should be indicated. If no voltage is indicated, replace the regulator.
4. If voltage was indicated in Step 3, disconnect the wiring plug from the alternator rectifier

connector. Again, contact the voltmeter positive lead to the regulator wiring plug S terminal. If voltage is ok indicated, service the S lead to the alternator plug to eliminate the voltage source. If no voltage is indicated, replace the alternator rectifier assembly.

**Indicator Lamp System**

The Integral Alternator Regulator (IAR) has a circuit in the regulator that will indicate a high battery voltage condition. With the IAR system, two conditions can cause the charge indicator lamp to come on during vehicle operation:

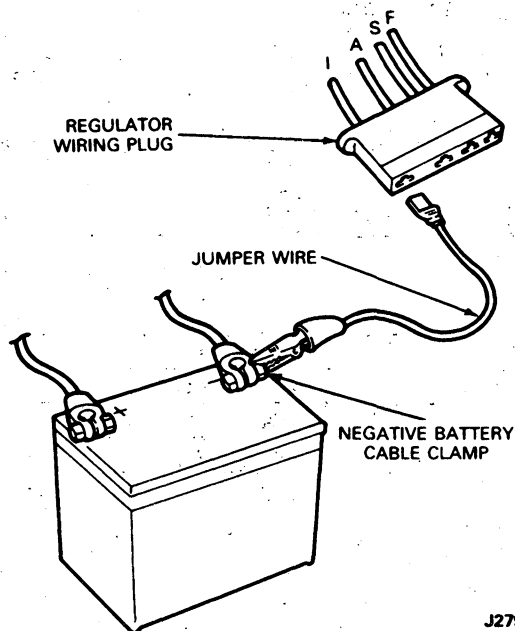
1. No alternator output—damaged alternator, regulator or wiring.
2. Overvoltage correlation—shorted alternator rotor, regulator or wiring.

If the system is working normally, the following conditions will be present:

- With ignition switch in OFF position—charge indicator battery symbol lamp is off.
- With ignition switch in RUN position (engine not running)—charge indicator (alternator) lamp is on.
- With ignition switch in RUN position (engine running)—charge indicator (alternator) lamp is off.

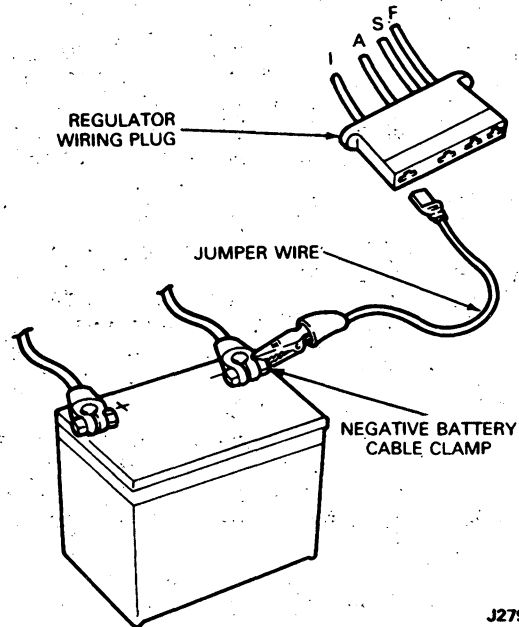
**DIAGNOSIS AND TESTING (Continued)****Electronic Voltage Regulator (EVR) System**

1. If the charge indicator lamp does not come on with the ignition switch in the RUN position (engine not running), check the I circuit (ignition switch to regulator I terminal) for an open circuit or burned out charge indicator lamp. Replace the lamp, if necessary.
2. If the charge indicator lamp does not come on, disconnect the wiring plug connector from the regulator. Connect a jumper wire from the I terminal of the regulator wiring plug to the negative battery post cable clamp.



J2797-1A

3. The charge indicator lamp should go on with the ignition key turned to the RUN position.
4. If the charge indicator lamp does not go on, check the ator wiring plug to the negative battery post cable clamp.

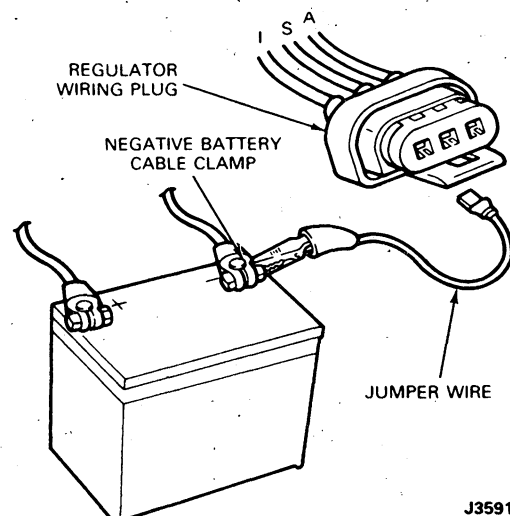


J2797-1A

3. The charge indicator lamp should go on with the ignition key turned to the RUN position.
4. If the charge indicator lamp does not go on, check the bulb for continuity and replace, if necessary.
5. If the bulb is not burned out, an open circuit exists between the ignition switch and the regulator. Check the 500 ohm resistor across the indicator lamp.

**Integral Alternator/Regulator (IAR) System**

1. If the charge indicator lamp does not come on, disconnect the wiring connector from the regulator.
2. Connect a jumper wire from the wiring connector I terminal to the battery negative post cable clamp.



J3591-1A



**DIAGNOSIS AND TESTING (Continued)**

3. Turn ignition to RUN position with engine off. If indicator lamp does not light, check for presence of bulb socket resistor. If resistor is missing, replace bulb socket. If resistor is present, check for contact of bulb socket leads to the flexible printed circuit. If good, check indicator bulb for continuity and replace bulb if burned out. If bulb checks good, perform regulator I circuit test.
4. If indicator lamp does light, remove jumper wire and reconnect wiring plug to regulator. Connect voltmeter negative lead to battery negative post cable clamp and contact voltmeter positive lead to regulator A terminal screw. Battery voltage should be indicated. If battery voltage is not indicated, service A circuit wiring.
5. If battery voltage is indicated, clean and tighten the ground connections to the engine, alternator and regulator. Tighten loose regulator mounting screws from 1.7 to 2.8 N·m (15-26 in-lb).
6. Turn the ignition switch to RUN position with the engine off. If the indicator lamp still does not light, replace the regulator.

**Ammeter System****Normal Charge Indication**

1. With the ignition switch OFF and no electrical load, the ammeter should show 0 on center scale.
2. With the ignition switch in the RUN position (engine running), (fully charged battery), the needle deflects toward charge and returns toward center scale in time.
3. With the ignition switch in OFF position and the headlamps on, the ammeter should show a discharge. If the ammeter does not register a discharge, check for loose connections at the ammeter or an open circuit wire. Replace the gauge, if necessary.

**Charging System Tests**

These short simple tests are performed with a volt-ohmmeter, a test lamp and a jumper wire. Follow the procedures carefully. These tests will help you find the cause of a charging problem. Perform these tests only after you have made preliminary inspections and fully charged the battery.

When performing charging system tests turn off all lamps and electrical accessories. Place the transmission in NEUTRAL and apply the parking brake.

**CAUTION: Do not make jumper wire connections except as directed. To do so may damage the regulator.**

NOTE: Battery posts and cable clamps must be clean and secure to assure accurate meter readings. top

**SPECIAL SERVICE TOOLS****ROTUNDA EQUIPMENT**

Model Number	Description
059-00002	Charging System Analyzer
007-00001	Digital Volt-Ohmmeter
059-00010	Inductive Dwell-Tach-Volt-Ohm Tester

CJ3293-1C

# SECTION 31-02 Batteries

SUBJECT	PAGE	SUBJECT	PAGE
<b>DIAGNOSIS AND TESTING</b>		<b>SERVICE</b>	
Battery Charging .....	31-02-3	Tools .....	31-02-7
Battery State of Charge .....	31-02-1	<b>SPECIAL SERVICE TOOLS</b> .....	31-02-9
<b>MAINTENANCE</b>		<b>SPECIFICATIONS</b> .....	31-02-9
Battery Cleaning .....	31-02-4	<b>VEHICLE APPLICATION</b> .....	31-02-1
Jump Starting .....	31-02-4		
<b>REMOVAL AND INSTALLATION</b>			
Battery .....	31-02-5		

## VEHICLE APPLICATION

All Models.

## DIAGNOSIS AND TESTING

Perform battery tests to determine the state of charge and also its capacity or ability to crank an engine. The ultimate result of these tests shows either that the battery is good, needs recharging, or must be replaced.

Prior to battery testing, thoroughly examine the battery for signs of damage.

**WARNING: BATTERIES NORMALLY PRODUCE EXPLOSIVE GASES WHICH CAN CAUSE PERSONAL INJURY. THEREFORE, DO NOT ALLOW FLAMES, SPARKS OR LIGHTED TOBACCO TO COME NEAR THE BATTERY. WHEN CHARGING OR WORKING NEAR A BATTERY, ALWAYS SHIELD YOUR FACE AND PROTECT YOUR EYES. ALWAYS PROVIDE VENTILATION.**

**WHEN LIFTING A PLASTIC-CASED BATTERY, EXCESSIVE PRESSURE ON THE END WALLS COULD CAUSE ACID TO SPEW THROUGH THE VENT CAPS, RESULTING IN PERSONAL INJURY. LIFT WITH A BATTERY CARRIER OR WITH YOUR HANDS ON OPPOSITE CORNERS.**

**WARNING: KEEP OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH SKIN OR EYES FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES AND SEEK PROMPT MEDICAL ATTENTION. IF ACID IS SWALLOWED, CALL A PHYSICIAN IMMEDIATELY.**

## Battery State of Charge

### Maintenance Free Batteries

Check the battery open circuit terminal voltage with a digital voltmeter such as Rotunda 007-00001 or equivalent, capable of reading 1/100 of a volt. If open circuit voltage of battery is below 12.4 volts and the battery has passed the capacity test, charge the battery.

### Conventional Batteries

Use a hydrometer or Rotunda Battery and Anti-Freeze Tester 021-00046 or equivalent to check the specific gravities of all cells.

In order to obtain an accurate specific gravity reading, it must be corrected to the standard temperature of 26°C (80°F). A correction factor of four points (0.004) is used for each 6°C (10°F) change in temperature. Add four points (0.004) to the indicated reading for each 6°C (10°F) increment above 26°C (80°F) and subtract four points (0.004) for each 6°C (10°F) increment below 26°C (80°F).

If the difference between cells is 50 points (0.050) or more, the battery is not satisfactory for service and should be replaced.







If the difference between cells is less than 50 points (0.050) and one or more cells are less than 1.225, charge the battery for 20 minutes at 35 amps and perform capacity test as outlined. If the battery fails, replace the battery. If it passes, add water if necessary and charge the battery.

If the difference between cells is less than 50 points (0.050) and all cells are above 1.225, perform the capacity test as outlined. If the battery fails, replace the battery. If it passes, return to service.

**DIAGNOSIS AND TESTING (Continued)**

Perform the following tests using Starting and Charging Tester 078-00005 or equivalent.



**BATTERY TESTING PROCEDURE**

TEST STEP		RESULT	ACTION TO TAKE
<b>A0</b>	<b>VISUAL INSPECTION</b>		
	<ul style="list-style-type: none"> <li>Remove negative cable, then positive cable.</li> <li>Check for dirty or corroded connections.</li> </ul>	<div>  </div>	CLEAN terminals and clamps. GO to A1.
		<div>  </div>	GO to A1.
<b>A1</b>	<b>LOOSE BATTERY POST</b>		
	<ul style="list-style-type: none"> <li>Check for loose battery post.</li> </ul>	<div>  </div>	REPLACE battery.
		<div>  </div>	GO to A2.
<b>A2</b>	<b>CRACKED BATTERY COVER</b>		
	<ul style="list-style-type: none"> <li>Remove hold-downs and shields.</li> <li>Check for broken/cracked case or cover.</li> </ul>	<div>  </div>	REPLACE Battery.
		<div>  </div>	GO to A3.

**CJ2732-2B**

## DIAGNOSIS AND TESTING (Continued)

## BATTERY TESTING PROCEDURE

TEST STEP		RESULT	ACTION TO TAKE																																					
A3	BATTERY CAPACITY TEST																																							
<p>Use a high rate discharge tester with a variable rate control or a fixed rate tester with meter compensation for different battery electrical sizes. Follow instructions supplied with tester for the battery capacity test.</p> <p>Recommended Discharge Rates</p> <table><thead><tr><th>Battery Rating (Ampere-Hrs.)</th><th>Discharge Rate (Amperes)</th></tr></thead><tbody><tr><td>54 Maintenance-Free</td><td>225</td></tr><tr><td>71 Maintenance-Free</td><td>235</td></tr><tr><td>81 Conventional Batt.</td><td>175</td></tr></tbody></table> <p>(Cold Cranking Amps)</p> <table><tbody><tr><td>850</td><td>425</td></tr><tr><td>700</td><td>350</td></tr><tr><td>650</td><td>325</td></tr><tr><td>535</td><td>260</td></tr><tr><td>450</td><td>225</td></tr></tbody></table> <p>Voltage Readings at 15 seconds For Good Battery (Battery Capacity Test).</p> <table><thead><tr><th>Approximate Battery Temperature</th><th>Minimum Voltage</th></tr></thead><tbody><tr><td>21°C (70°F)</td><td>And Above</td></tr><tr><td>16°C (60°F)</td><td>9.6</td></tr><tr><td>10°C (50°F)</td><td>9.5</td></tr><tr><td>4°C (40°F)</td><td>9.4</td></tr><tr><td>- 1°C (30°F)</td><td>9.3</td></tr><tr><td>- 7°C (20°F)</td><td>9.1</td></tr><tr><td>- 12°C (10°F)</td><td>8.9</td></tr><tr><td>- 18°C ( 0°F)</td><td>8.7</td></tr><tr><td></td><td>8.5</td></tr></tbody></table>		Battery Rating (Ampere-Hrs.)	Discharge Rate (Amperes)	54 Maintenance-Free	225	71 Maintenance-Free	235	81 Conventional Batt.	175	850	425	700	350	650	325	535	260	450	225	Approximate Battery Temperature	Minimum Voltage	21°C (70°F)	And Above	16°C (60°F)	9.6	10°C (50°F)	9.5	4°C (40°F)	9.4	- 1°C (30°F)	9.3	- 7°C (20°F)	9.1	- 12°C (10°F)	8.9	- 18°C ( 0°F)	8.7		8.5	<div><div></div><div>CHARGE battery for 20 minutes at 35 amps. REPEAT Step A3. (If battery fails second check, REPLACE battery.)</div></div> <div><div></div><div>GO to A4.</div></div>
Battery Rating (Ampere-Hrs.)	Discharge Rate (Amperes)																																							
54 Maintenance-Free	225																																							
71 Maintenance-Free	235																																							
81 Conventional Batt.	175																																							
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- 12°C (10°F)	8.9																																							
- 18°C ( 0°F)	8.7																																							
	8.5																																							
A4	VOLTAGE CHECK																																							
<ul style="list-style-type: none"><li>Measure open circuit voltage of battery with a digital voltmeter capable of reading 1/100 volt.</li></ul>		<div><div>OVER 12.4 Volts</div><div>▶ Battery OK.</div></div> <div><div>12.4 Volts or less</div><div>▶ CHARGE battery.</div></div>																																						

CJ2701-2F

## Battery Charging

Before recharging a discharged battery, inspect and service the following conditions, if they exist:

1. Loose alternator belt.
2. Pinched or grounded alternator voltage regulator wiring harness.
3. Loose harness connections at the alternator and/or voltage regulator.
4. Loose or corroded connections at battery, starter relay and/or engine ground.
5. Excessive battery drain due to hood, glove compartment and courtesy lamps remaining energized (damaged or misadjusted switch, glove compartment left open, etc.).

## DIAGNOSIS AND TESTING (Continued)

### Maintenance Free and Conventional Batteries

Cold batteries will not readily accept a charge. Therefore, batteries should be allowed to warm up to approximately 5°C (40°F) before charging. This may require 4 to 8 hours at room temperature. Warming time depends upon initial temperature and battery size.

A battery which has been completely discharged may be slow to accept a charge initially. In some cases batteries may not accept a charge at the normal charger setting. When batteries are in this condition, charging can be started by using the dead battery switch on chargers so equipped.

Completely discharged batteries, which have been discharged for a prolonged period of time (over one month) or which have an open circuit voltage of less than two volts, may show no indication of accepting a charge even when the dead battery switch is used. The initial charge rate of batteries in this condition is so low that some charger ammeters will not show any indication of charge for up to 10 minutes.

Determine whether a battery accepts charge as follows: Follow charger manufacturer's instructions for use of dead battery switch. If dead battery switch is the spring-loaded type, it should be held in the ON position for up to three minutes. After releasing dead battery switch and with charger still on, measure battery voltage. If it shows 12 volts or higher, the battery is accepting a charge and is capable of being recharged. However, cold batteries below 5°C (40°F) may require up to two hours of charging before the charge rate is high enough to show on the charger ammeter. All non-damaged batteries can be charged by this procedure. If a battery cannot be charged by this procedure it should be replaced.

Once it has been determined that the battery has begun to accept a charge, it can be charged to a serviceable state or a full state of charge using one of two following methods:

- The **first method** uses the AUTOMATIC setting on chargers so equipped. This setting maintains the charging rate within safe limits by adjusting voltage and current to prevent excessive gassing and spewing of electrolyte. Approximately 2 to 4 hours will be required to charge a completely discharged battery to a serviceable state. If a full state of charge is desired, the charge can be completed by a low current rate of 3 to 5 amps for several additional hours.
- The **second method** uses the MANUAL or constant current setting on the charger. Initially set the charging rate for 30 to 40 amps and maintain this setting for approximately 30 minutes or as long as there is no excessive gassing and electrolyte spewing. If gassing results, the charge rate must be reduced to a level where gassing will stop. Excessive gassing will result in non-replaceable loss of electrolyte, thus shortening battery life.

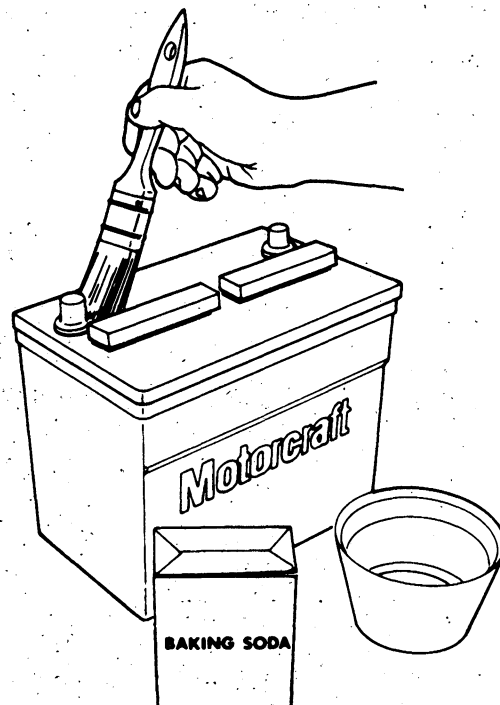
The total charge required will vary with battery size and its initial state of charge. In general, to bring a discharged battery to a serviceable state of charge, current-time input should equal the battery amp-hour capacity. For example: A 45 AH battery will require 15 amps of charge for 3 hours, or 9 amps of charge for 5 hours. Again, if a full state of charge is desired, the charge can be completed by a low constant current of 3 to 5 amps for several hours.

If the battery has failed, or is low in charge, it may be necessary to refer to Diagnosis, Section 31-01, Charging System General Service.

## MAINTENANCE

### Battery Cleaning

Keeping the battery top clean and dry reduces the need for service and extends battery life. Also, make certain that the cable clamps are tightly fastened to the battery posts. If corrosion is found, disconnect the cables and clean clamps and posts with a wire brush. Neutralize the corrosion with a solution of baking soda and water. After installing cables, apply a small quantity of Long-Life Lubricant C1AZ-19590-BA or equivalent grease to each battery post to help prevent corrosion.



J3285-1A

### Jump Starting

Refer to Section 28-01, Starting System General Service.

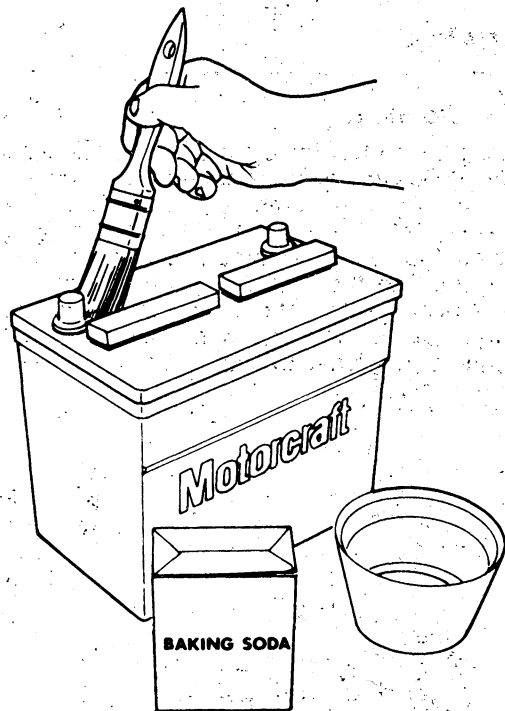
## REMOVAL AND INSTALLATION

### Battery

#### Removal

NOTE: The illustrations used in the following procedures show typical battery locations and connections.

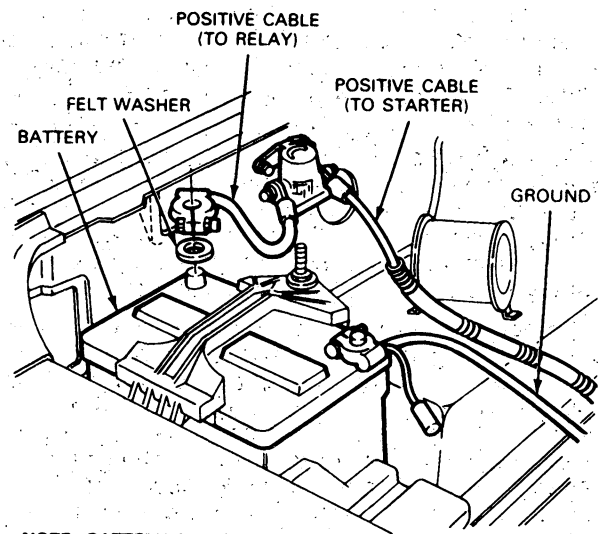
1. Remove battery cables from battery terminals (negative first).
2. Clean cable terminals with an acid neutralizing solution and terminal cleaning brush.



J3285-1A

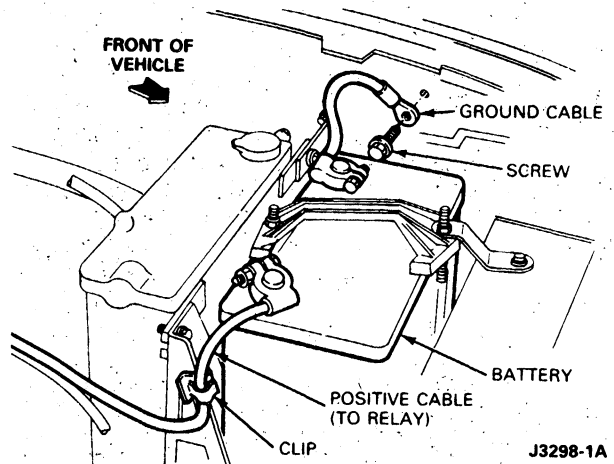
3. Remove hold-down clamps.
4. Test battery and determine if it should be:
  - Returned to service.
  - Recharged before being returned to service.
  - Replaced with a Motorcraft or equivalent battery.

### Battery Connections—Standard (R.H.)



J3297-1A

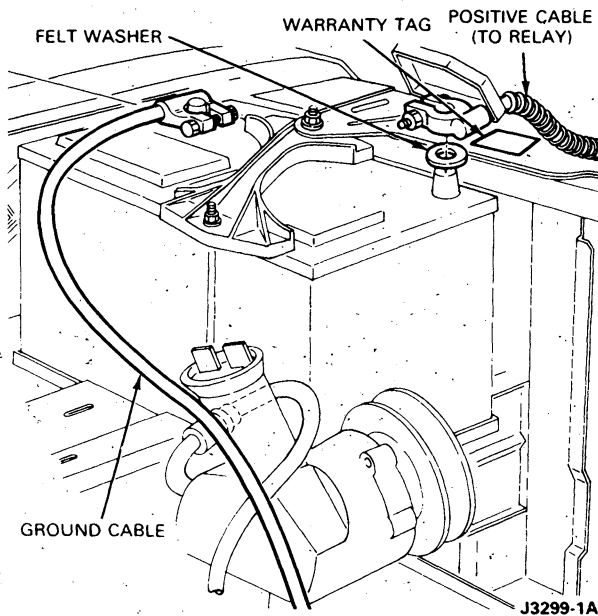
### Battery Connections with Dual Batteries (L.H.)



J3298-1A

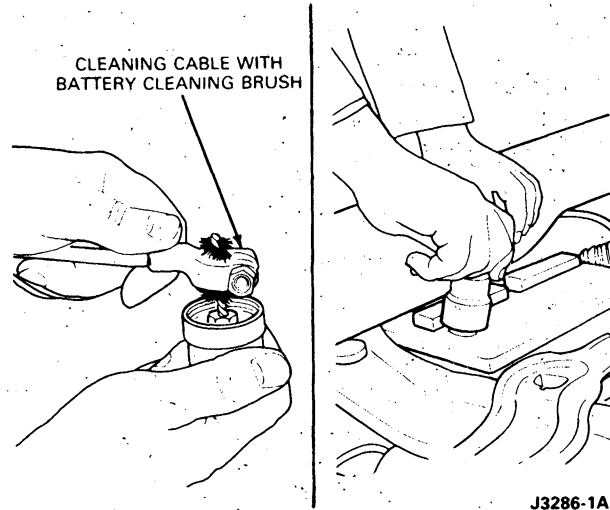
## REMOVAL AND INSTALLATION (Continued)

## Battery Connections with 7.3L Diesel Engine (L.H.)

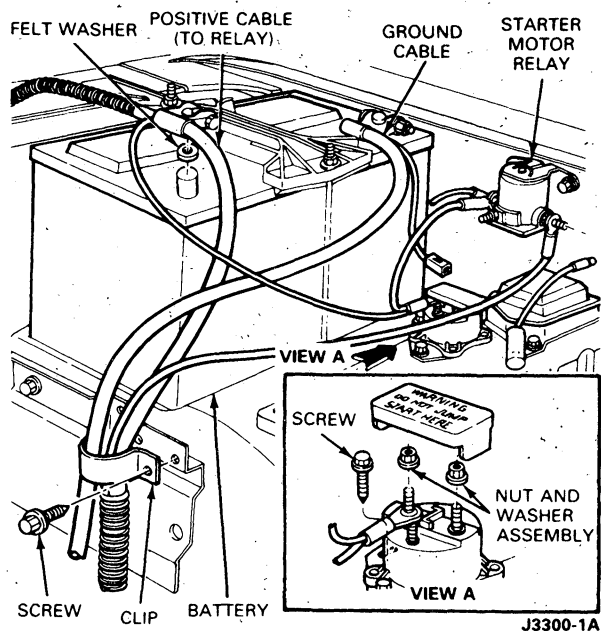


## Installation

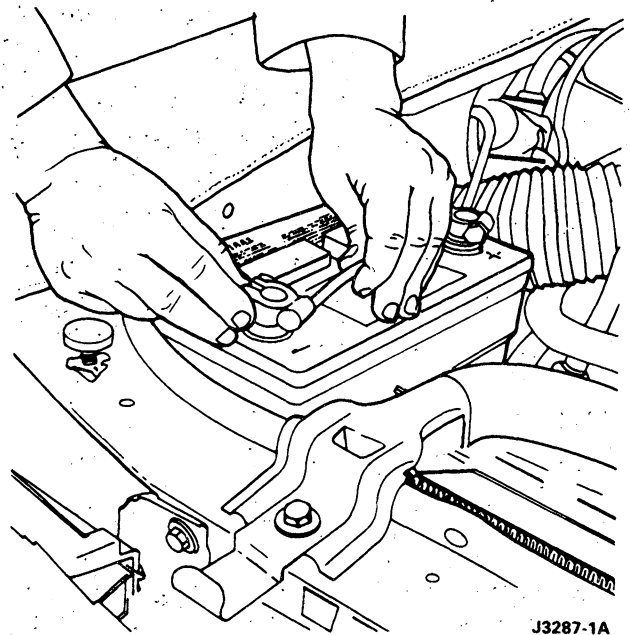
1. Clean cable terminals and hold-down with a wire brush. Replace all cables or parts that are worn or frayed.



## Battery Connections with 7.3L Diesel Engine (R.H.)



2. Clean battery tray with a wire brush and scraper.
3. Place battery into tray with positive and negative terminals in same position as originally installed battery. Assemble and tighten hold-down hardware to ensure that battery is secure. Do not overtighten.
4. Secure cables (positive first) to proper terminals. **Do not overtighten.** Apply a small quantity of Long Life Lubricant C1AZ-19590-BA or equivalent to terminals.



## SERVICE

### Tools

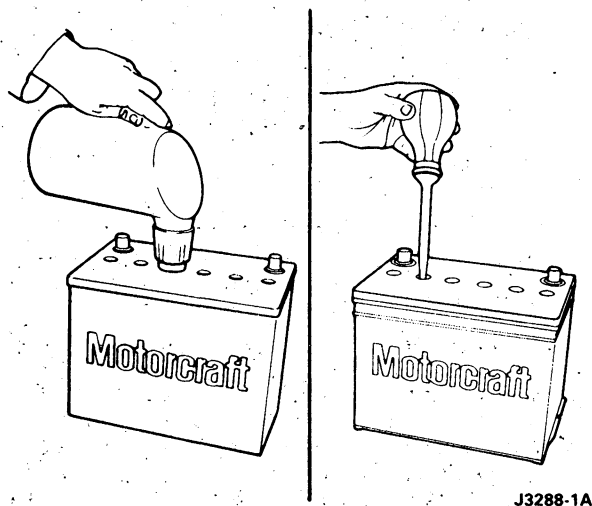
Anyone servicing a battery needs the proper tools. Properly designed tools will help prevent damage to the battery, battery cables and hold-down bracketry. Their use decreases potential hazard to both the technician and the vehicle being serviced.

Tools and equipment manufactured for servicing batteries have parts insulated to help prevent arcing. This feature reduces potential fire hazard should the tool be dropped or otherwise accidentally establish an arc-producing current path.

### Battery Filling Devices

#### Batteries with Removable Vent Caps

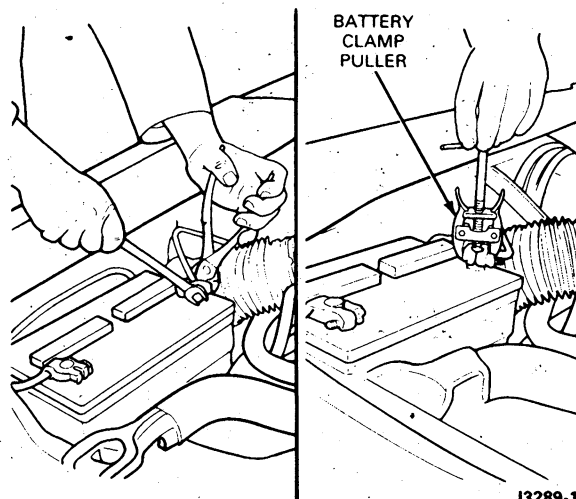
One of the most important on-the-vehicle services is to maintain the correct battery electrolyte level. Two devices are available for this purpose: a self-leveling filler which allows the battery to be filled to a predetermined level automatically, and the syringe type filler.



J3288-1A

### Battery Pliers

Battery pliers have jaws specifically designed for gripping cable clamp bolts securely. Exercise care when removing or replacing the cable clamp bolts so that the battery terminal is not subjected to any excessive lateral or twisting forces. Such forces could cause major damage to the internal components of the battery and result in leakage at the terminals.



J3289-1A

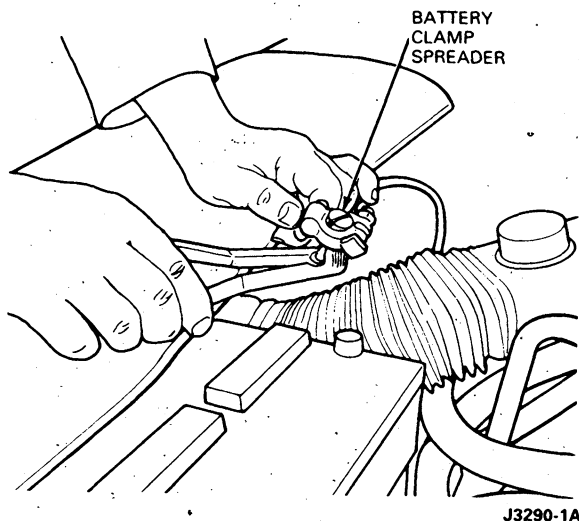
### Battery Cable Puller

Use a cable puller to remove a cable clamp from the battery terminal. Jaws, gripping the underside of the cable clamp, pull the clamp up by means of pressure exerted against the top of the battery terminal. Proper use of this tool avoids the damaging lateral or twisting forces that result when using a pry bar or pliers to remove the battery clamp. Refer to the illustration shown under Battery Pliers.



**SERVICE (Continued)****Battery Cable Clamp Spreader**

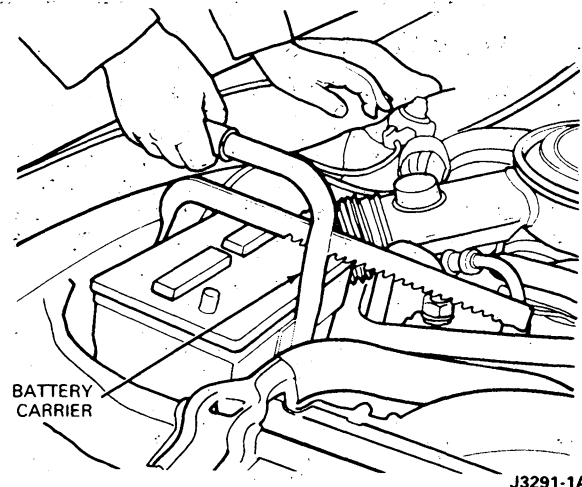
The spreader is used to expand the cable clamp after it has been removed from the terminal and the clamp bolt has been loosened. The cable clamp can then be fully and properly installed onto the battery terminal.

**Terminal Cleaning Brush**

The terminal cleaning brush is designed with units to clean both the tapered battery terminal and the mating surface of the cable clamp. Refer to illustration under Battery Installation, Step 1.

**Battery Carrier**

Use a suitable battery carrier for lifting and transporting the battery. The illustration shows a clamp-type carrier used to grip the sidewalls of the container just below the lip of the cover. The carrier is used on the sidewalls, rather than the endwalls, since the sidewalls have additional strength from the inner cell partitions. This is particularly important with polypropylene-cased batteries. Gripping the flexible endwalls on this type of battery could cause electrolyte to spew from some of the cells, and possibly cause damage to some of the internal components.

**Adding Water**

Some batteries have removable vent caps and may occasionally require the addition of water. If the electrolyte level is below the level indicator in any cell, add enough pure water to bring the level up to the indicator. In batteries without level indicator, maintain electrolyte level at 6.3 to 12.7mm (1/4 to 1/2 inch) above the plates. **Never add electrolyte ("battery acid") to the battery.** This could shorten the battery's life.

**SPECIFICATIONS****BATTERY CHARGING TIME SCHEDULE**

Battery Type	Rating (Ampere-Hours)	Slow Charging Rate/Time	Fast Charging Rate/Time
Motorcraft	45	5 amperes/9 hours	20 amperes/2 hours
	63	5 amperes/12 hours	20 amperes/3 hours
	71	5 amperes/14 hours	20 amperes/3 hours
	93	5 amperes/18 hours	20 amperes/4 hours
	78	5 amperes/15 hours	20 amperes/3.5 hours
	96	5 amperes/18 hours	20 amperes/4 hours

CJ2568-2D

**SPECIAL SERVICE TOOLS****ROTUNDA EQUIPMENT**

Tool Number	Description
078-00005	Starting and Charging Tester
021-00046	Battery and Anti-Freeze Tester

CJ3682-1A

# SECTION 31-17 Alternator—Integral Regulator

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS .....	31-17-2	TESTING (Cont'd.)	
DESCRIPTION AND OPERATION .....	31-17-1	Radio Suppression Capacitor Open or	
DISASSEMBLY AND ASSEMBLY .....	31-17-9	Short Test .....	31-17-6
REMOVAL AND INSTALLATION .....	31-17-8	Rectifier Assembly Test .....	31-17-5
SPECIAL SERVICE TOOLS .....	31-17-16	Stator Coil Grounded Test .....	31-17-7
SPECIFICATIONS .....	31-17-16	Stator Coil Open Test .....	31-17-7
TESTING		VEHICLE APPLICATION .....	31-17-1
Bench Tests .....	31-17-3		

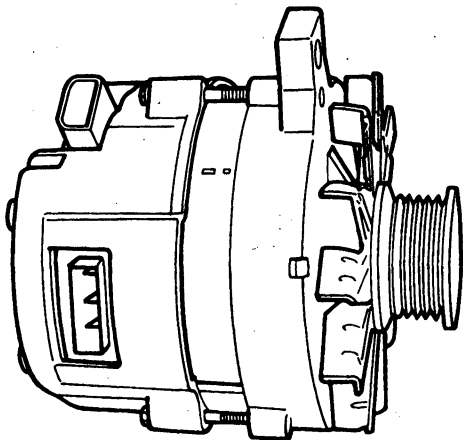
## VEHICLE APPLICATION

F-150, F-250, F-350, F-Super Duty, Bronco, E-150, E-250, E-350 Truck Models.

## DESCRIPTION AND OPERATION

The integral alternator/regulator (IAR) is belt-driven from the engine. Field current is supplied from the alternator regulator, mounted on the rear of the alternator, to the rotating field of the alternator through two brushes and two slip rings.

IAR ALTERNATOR



J3170-1A

The alternator produces power in the form of alternating current. The alternating current is rectified to direct current by six diodes. The alternator regulator automatically adjusts the alternator field current to maintain the alternator output voltage within prescribed limits to correctly charge the battery. The alternator is self-current limiting.

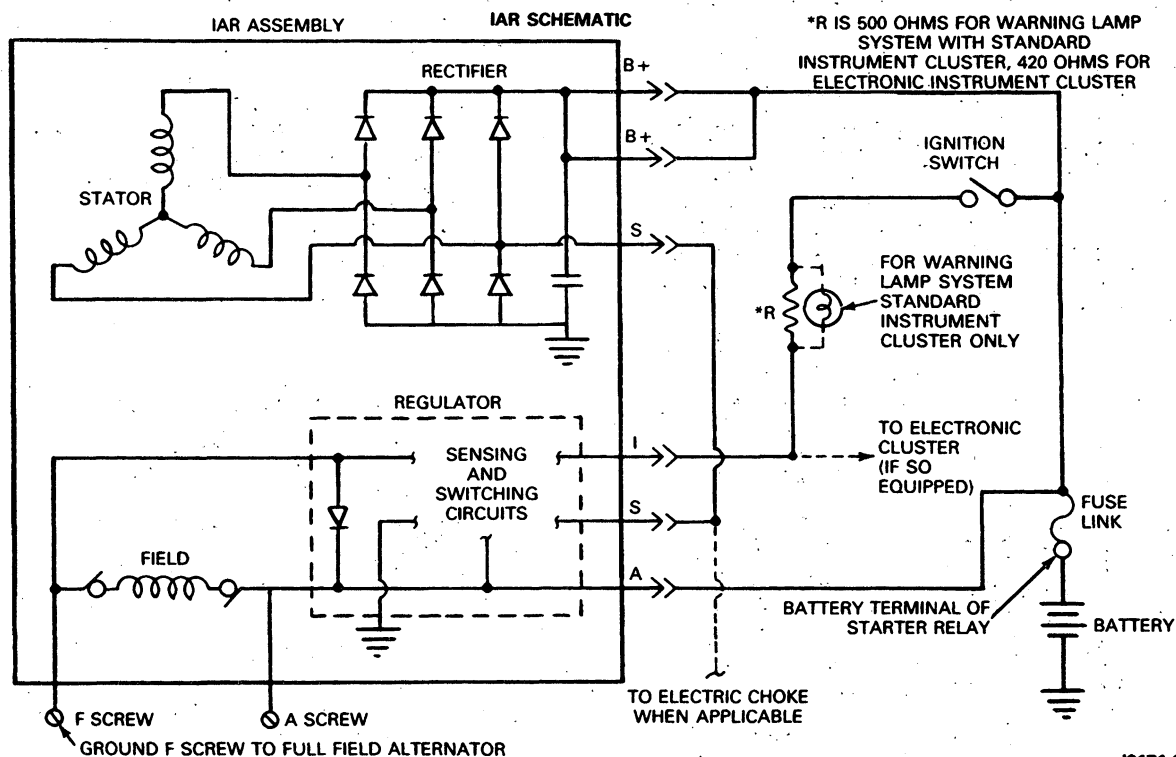
If equipped with a warning lamp, the regulator voltage control circuit is turned on when the ignition switch is in RUN and voltage is applied to the regulator I terminal through a resistor in the I circuit. When the ignition switch is in OFF, the control circuit is turned off and no field current flows to the alternator.

On warning lamp equipped vehicles, the warning lamp is connected across the terminals of a 500 ohm resistor\* at the instrument cluster. Current passes through the warning lamp when the ignition switch is in RUN and there is no voltage at terminal S. When voltage at S rises to a preset value, the regulator switching circuits stop the flow of current into terminal I and the lamp turns off.

## DESCRIPTION AND OPERATION (Continued)

System voltage is "sensed" and alternator field current is drawn through terminal A. The regulator switching circuits will turn the warning lamp on, indicating a system fault, if terminal A voltage is excessively high or if the terminal S voltage signal is abnormal.

A fuse link is included in the charging system wiring on all models. The fuse link is used to prevent damage to the wiring harness and alternator if the wiring harness should become grounded, or if a booster battery is connected to the charging system with the wrong polarity.



J3171-2B

## ADJUSTMENTS

Refer to Section 27-06, Accessory Drive Belt, Service, for drive belt adjustments.

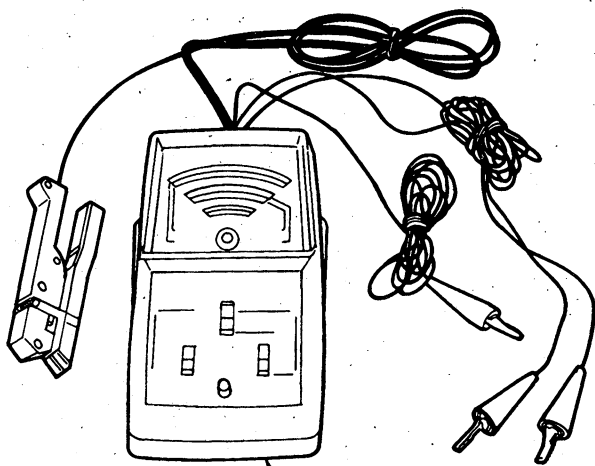
## TESTING

### Bench Tests

If system diagnosis has isolated a problem in the integral alternator/regulator assembly, remove it from vehicle for bench testing and service or replace. Refer to Removal and Disassembly. In some cases, it may be possible to replace a damaged regulator or brushes without removing the IAR assembly.

The following tests are performed with an analog (needle-type) ohmmeter. Test values shown are referenced to Rotunda Dwell-Tach-Volt-Ohmmeter 059-00010 or equivalent. THESE VALUES MAY BE DIFFERENT FOR OTHER OHMMETERS. If you do not have Rotunda Dwell-Tach-Voly-Ohmmeter 059-00010 or equivalent, use known good parts to establish reference values for your own meter. These values can be written into the spaces provided in the meter reading charts for future reference.

DWELL TACH VOLT-OHMMETER - ROTUNDA 059-00010



ROTUNDA MODEL  
059-00010

J3172-1B

### Rectifier and Stator Grounded Tests

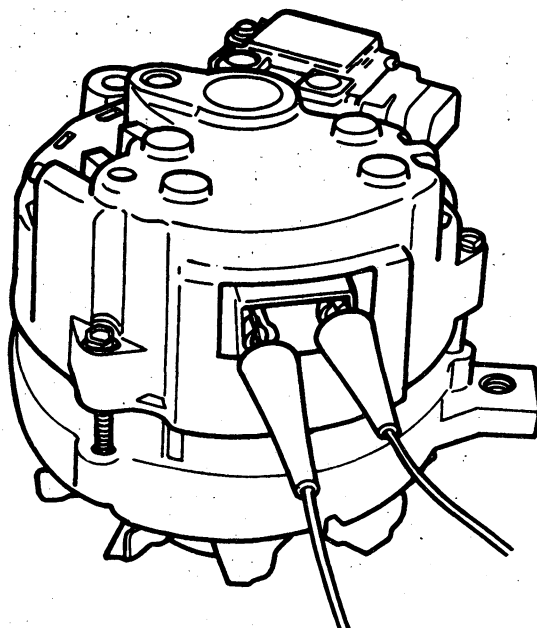
This test is performed with an ohmmeter, Rotunda Dwell-Tach-Volt-Ohmmeter 059-00010 or equivalent. Place the Multiply-By setting at 1 and calibrate the ohmmeter as directed.

NOTE: Text values shown in brackets [ ] \_\_\_\_ are referenced to Rotunda Dwell-Tach-Volt-Ohmmeter 059-00010, and may be different if another tester is used.

**CAUTION:** Digital meters cannot be used to perform these rectifier tests.

1. Contact one ohmmeter probe of one of the alternator B+ blade terminals and the other probe to the STA blade terminal. Then, reverse the ohmmeter probes and repeat the test. Normally, there will be no needle movement in one direction, indicating the rectifier diodes are being checked in the reverse current direction and are not shorted. A low reading of about [6.5] \_\_\_\_ ohms with the probes reversed indicates that rectifier positive diodes are being checked in the forward current direction. A reading in both directions indicates a bad positive diode or shorted radio suppression capacitor. The radio suppression capacitor is built into the rectifier assembly and is not individually serviceable.

RECTIFIER POSITIVE DIODE TEST



#### METER READING

Set meter to Ohms x 1. Make reading in both directions.

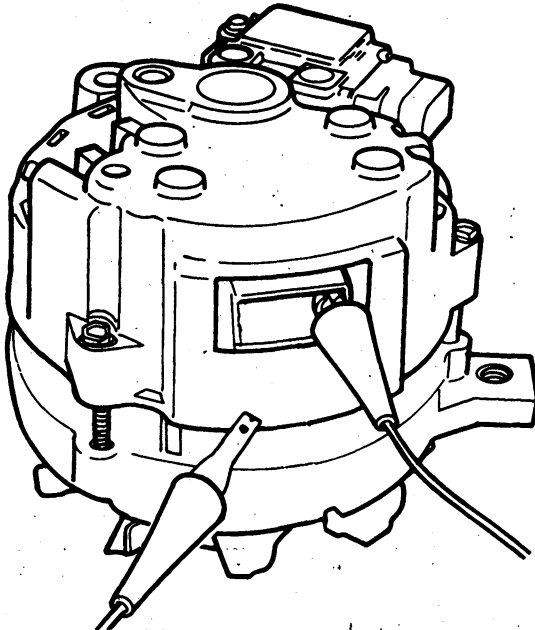
Resistance Measurement		Only Acceptable Reading	
BAT Terminal	to STA Terminal	Model 059-00010	Reference for Another Meter
One probe position		∞	∞
Other probe position		About (6.5) ohms	About ____ ohms

CJ3251-1A

**TESTING (Continued)**

2. Perform the same test using the STA blade terminal and alternator rear housing. A reading in both directions indicates either a grounded stator winding, a damaged negative diode, a grounded stator lead wire or a shorted radio suppression capacitor.

**RECTIFIER NEGATIVE DIODE  
AND STATOR GROUNDED TEST**



METER READING		
Set meter to Ohms x 1. Make readings in both directions.		
Resistance Measurement	Only Acceptable Reading	
GND to STA Terminal	Model 059-00010	Reference for Another Meter
One probe position	$\infty$	$\infty$
Other probe position	About (6.5) ohms	About ____ ohms

CJ3173-1A

3. If there is no needle movement with the probes in one direction and no needle movement or high resistance (significantly over [6.5] \_\_\_\_ ohms) in the opposite direction for Test 1 and 2, a bad connection exists in the rectifier assembly.

**Field Open or Short Circuit Test**

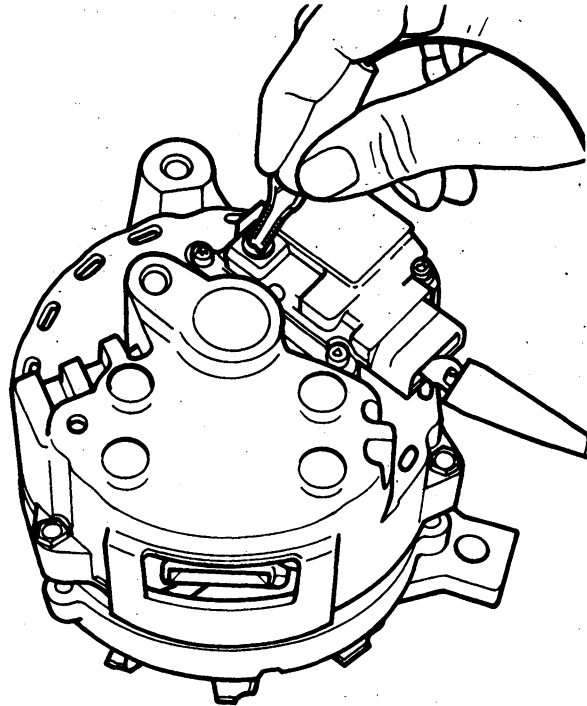
This test is performed with an ohmmeter. Rotunda Dwell-Tach-Volt-Ohmmeter 059-00010 or equivalent.

Place the Multiply-By setting at 1 and calibrate the ohmmeter as directed.

1. Contact the regulator A blade terminal with one probe and the regulator F screw head with the other probe. Spin the alternator pulley.

Reverse the ohmmeter probes and repeat the test. In one probe direction, the ohmmeter reading should be between 2.2 and 100 ohms (on Rotunda meter) and may fluctuate while the pulley is turning. In the other probe direction, the reading should fluctuate between 2.2 and about [9] \_\_\_\_ ohms.

**FIELD OPEN OR SHORT CIRCUIT TEST**



METER READING		
Set meter at Ohms x 1. Make readings in both directions. Spin pulley while taking reading.		
Resistance Measurement	Only Acceptable Reading	
Regulator A Blade Terminal to Regulator F Screw Head	Tool 059-00010	Reference for Another Meter
One probe position	2.2 to 100 ohms	2.2 to 100 ohms
Other probe position	2.2 to [9] ohms	2.2 to ____ ohms

CJ3175-1A

**TESTING (Continued)**

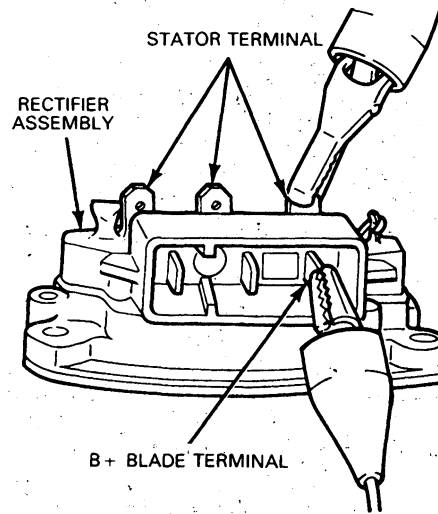
2. An infinite reading (no meter movement) in one direction and approximately [9] \_\_\_\_ ohms in the other, indicates an open brush lead, worn or stuck brushes, a damaged rotor or a loose regulator to brush holder attaching screw.
3. An ohmmeter reading less than [2.2] \_\_\_\_ ohms in both directions indicates a shorted rotor or damaged regulator.
4. An ohmmeter reading significantly over [9] \_\_\_\_ ohms in both directions indicates an inoperative regulator or loose F terminal screw.
5. Contact the alternator rear housing with one ohmmeter probe and touch the other probe to the regulator F terminal. Reverse the probes and repeat the test. The ohmmeter reading should be infinite in one probe direction and approximately [9] \_\_\_\_ ohms in the other. A reading less than infinite in both directions indicates a grounded brush lead or an inoperative regulator. A reading significantly over [9] \_\_\_\_ ohms in both directions indicates an inoperative regulator or a damaged A terminal connection.

**Rectifier Assembly Test**

Remove the rectifier assembly from the alternator. Place the Rotunda 059-00010 or equivalent, Multiply-By setting at 1 and calibrate the meter as directed.

**CAUTION:** Digital meters cannot be used to perform these tests.

1. To test the positive diodes, contact one probe to one of the rectifier assembly B+ blade terminals and contact each of the three stator terminals with the other probe. Reverse the probes and repeat the test. All diodes should show a low reading of approximately [7] \_\_\_\_ ohms in one direction and an infinite reading (no needle movement) with the probes reversed. This reading may be checked against a good rectifier if one is available.

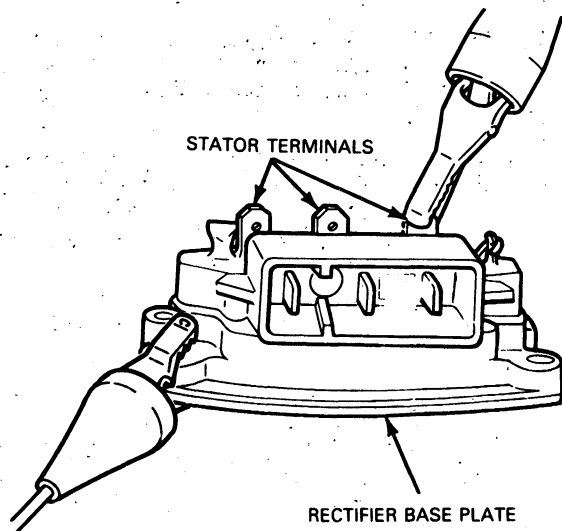


METER READING			
Set meter at Ohms x 1. Make readings in both directions to all three phase terminals.			
Resistance Measurement	Only Acceptable Reading		
B+ Terminal to Phase Terminal	Tool 059-00010	Reference for Another Meter	
One probe direction; each phase terminal	About [7.0] ohms	About ____ ohms	
Other probe direction; each phase terminal	∞	∞	

CJ3275-1B

**TESTING (Continued)**

2. Perform the preceding tests for the negative diodes by contacting the rectifier assembly base plate and the three stator terminals.



Meter Reading		
Set meter at Ohms x 1. Make readings in both directions to all three phase terminals.		
Resistance Measurement	Only Acceptable Reading	
Base Plate to Phase Terminal	Tool 059-00010	Reference for Another Meter
One probe direction; each phase terminal	About 7.0 ohms	About ____ ohms
Other probe direction; each phase terminal	$\infty$	$\infty$

CJ3276-1C

3. If the meter readings are not as specified, replace the rectifier assembly.

**Radio Suppression Capacitor Open or Short Test**

**NOTE:** This is an open or short circuit test only and does not measure capacitance value. Actual capacitance value should be measured on a capacitance bridge at 1 kHz at a maximum voltage of 350 mV rms.

The radio noise suppression capacitor is built into the rectifier assembly and cannot be serviced by itself. To test the capacitor, place the Rotunda 059-00010 or equivalent, Multiply-By setting at 1000 and zero the meter. Text values shown in brackets [ ] \_\_\_\_ are referenced to Rotunda Model 059-00010 and may be different if another tester is used.

**CAUTION:** Digital meters cannot be used to perform this capacitor test. The rectifier assembly must be dry.

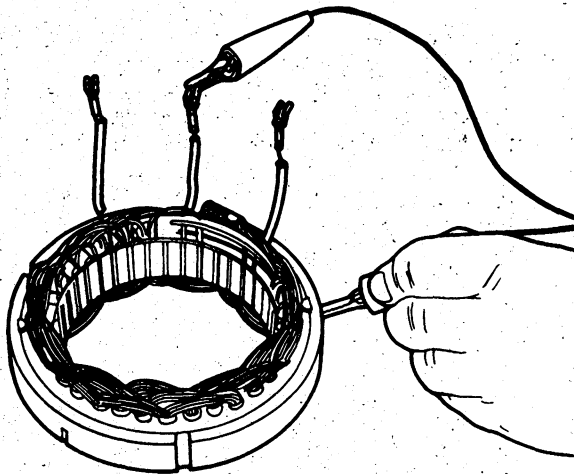
1. Contact one probe to one of the rectifier assembly B+ blade terminals and contact the other probe to the rectifier assembly base plate. Reverse the probes and repeat the test. One position should give an infinite reading, indicating the reverse current direction through the diodes and the other position should give a reading of about [1000] \_\_\_\_ ohms, indicating the forward current direction. The same reading in both directions indicates an inoperative rectifier assembly.
2. To check the capacitor, contact the probes to the rectifier assembly B+ terminal and base plate in the forward current [1000] \_\_\_\_ ohms reading direction. While observing the meter indicator needle, reverse the probes and again contact them to the rectifier assembly B+ terminal and base plate. The indicator needle should jump slightly (indicating that the ohmmeter batteries are charging the capacitor) and then return to its original position (infinite reading). If the needle does not jump, the capacitor is open. Replace the rectifier assembly.



**TESTING (Continued)****Stator Coil Grounded Test**

These tests are made to determine if the stator coil is shorted to ground. Remove the stator from the alternator and disconnect it from the rectifier assembly as outlined. Place the ohmmeter Multiply-By setting at 1000.

1. Connect the ohmmeter probes to one of the stator lead terminals and to the stator laminated core. Ensure that the probe makes a good electrical connection with the stator core. The meter should show an infinite reading (no needle movement).
2. If the meter does not indicate an infinite reading (needle moves), the stator winding is grounded to the core and the stator must be replaced.



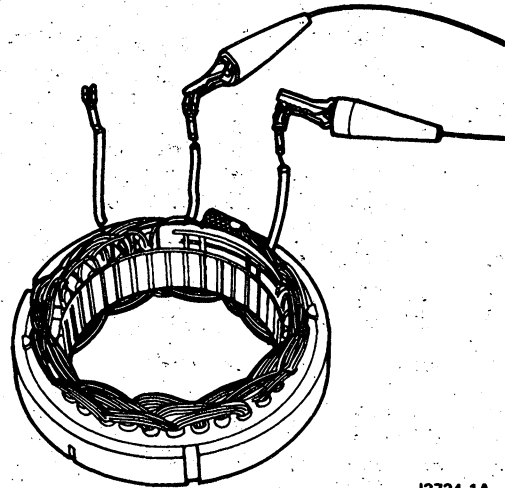
METER READING		
Set meter at Ohms x 1000. Make reading for all stator leads. DO NOT TOUCH LEADS WITH HANDS.		
Resistance Measurement	Only Acceptable Reading	
Stator Terminal to Stator Core	Tool 059-00010	Reference for Another Meter
All stator lead combinations; probe polarity optional	$\infty$	$\infty$

CJ3254-1A

**Stator Coil Open Test**

This test determines if there is an open stator circuit. Disconnect the stator from the rectifier assembly. Place the ohmmeter Multiply-By setting at 1.

1. Connect one ohmmeter probe to a stator phase lead terminal and touch the other probe to another stator lead terminal. Check the meter reading.
2. Repeat this test with the other two stator lead combinations. If no meter movement occurs (infinite resistance) on a lead paired with either of the other phase leads, that phase is open and the stator must be replaced.



J2724-1A

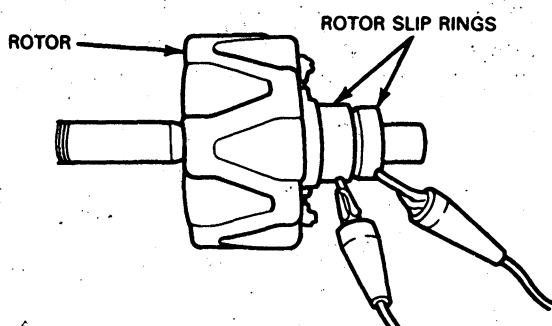
Meter Reading		
Set meter at Ohms x 1. Make readings for all stator lead combinations.		
Resistance Measurement	Acceptable reading	
Stator Terminal to Stator Terminal	Tool 059-00010	Reference For Another Meter
All lead combinations; Probe polarity optional	Less than 0.5 ohms	Less than 0.5 ohms

CJ3833-1A

**TESTING (Continued)****Rotor Open or Short Test**

Remove the rotor from the alternator. Place the ohmmeter Multiply-By setting at 1 and calibrate the meter as directed.

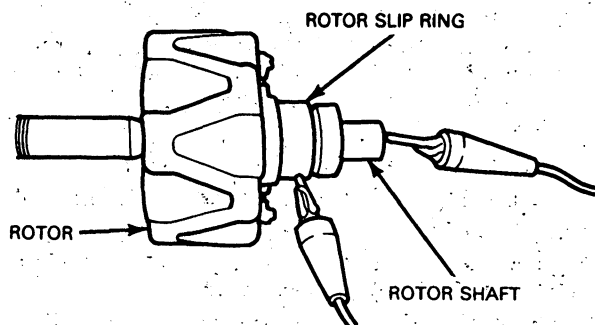
1. Contact each ohmmeter probe to a rotor slip ring. The meter reading should be [2.0-3.9] \_\_\_\_ ohms.
2. A higher reading indicates a damaged slip ring, welded connection or a broken wire. A lower reading indicates a shorted wire or slip ring. Replace the rotor if it is damaged and cannot be serviced.



METER READING			
Set meter at Ohms x 1.			
Resistance Measurement		Only Acceptable Reading	
Slip Ring	to Slip Ring	Tool 059-00010	Reference for Another Meter
Probe polarity optional		2.0 to 3.9 ohms	2.0 to 3.9 ohms

CJ3279-1A

3. Contact one ohmmeter probe to a slip ring and the other probe to the rotor shaft. The meter reading should be infinite (no needle movement).
4. A reading other than infinite indicates the rotor coil is grounded to the shaft. Replace the rotor if it is grounded and cannot be serviced.



METER READING			
Set meter at Ohms x 1.			
Resistance Measurement		Only Acceptable Reading	
Slip Ring	to Rotor Shaft	Tool 059-00010	Reference for Another Meter
Either slip ring; probe polarity optional		$\infty$	$\infty$

CJ3280-1A

**REMOVAL AND INSTALLATION**

**WARNING: HYDROGEN AND OXYGEN GASES ARE PRODUCED DURING NORMAL BATTERY OPERATION. THIS GAS MIXTURE CAN EXPLODE IF FLAMES, SPARKS OR LIGHTED TOBACCO ARE BROUGHT NEAR THE BATTERY. WHEN CHARGING OR USING A BATTERY IN AN ENCLOSED SPACE, ALWAYS PROVIDE VENTILATION AND SHIELD YOUR EYES.**

**WARNING: KEEP BATTERIES OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION, IN CASE OF ACID CONTACT WITH THE SKIN, EYES OR CLOTHING, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.**

**REMOVAL AND INSTALLATION (Continued)****Removal**

1. Disconnect battery ground cable.
2. Disconnect the wire harness attachments to the integral alternator/regulator assembly. Pull the two connectors straight out.
3. Loosen the alternator pivot bolt. Remove the adjustment arm bolt from the alternator.
4. Disengage the alternator drive belt from the alternator pulley.
5. Remove the alternator pivot bolt and alternator/regulator assembly.
6. Remove the alternator fan shield, if so equipped.

**Installation**

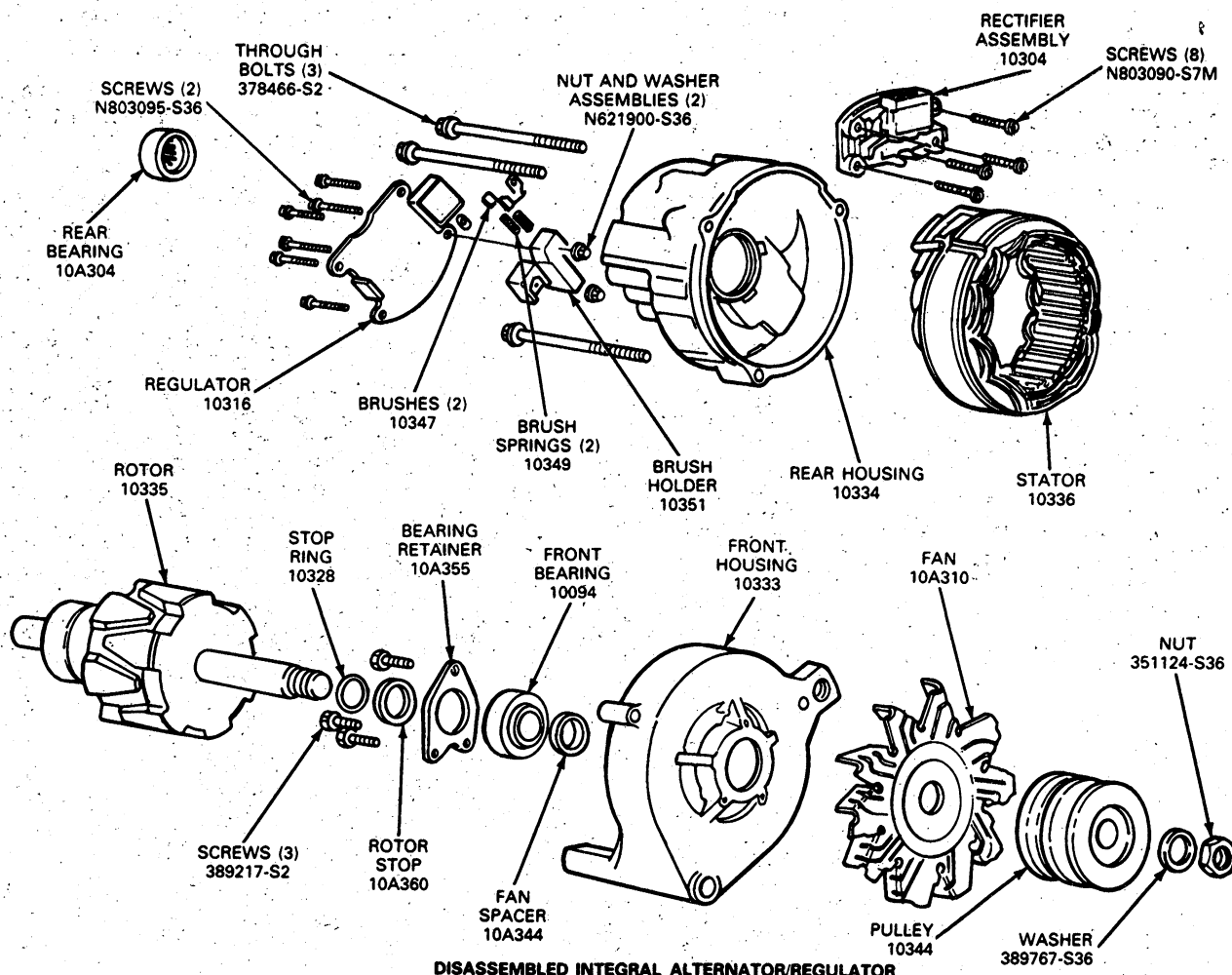
1. Position the integral alternator/regulator assembly on the engine.

2. Install the alternator pivot and adjuster arm bolts, but do not tighten the bolts until the belt is tensioned.
3. Install the drive belt over the alternator pulley.
4. Adjust the belt tension and tighten the adjuster and pivot bolts to specification. Check belt tension using Belt Tension Gauge T63L-8620-A or Rotunda Belt Tension Gauge 021-00019 or equivalent. Apply pressure to alternator front housing only when adjusting belt tension. Refer to Section 27-06, Accessory Drive Belts.
5. Connect the wiring harness to the alternator/regulator assembly. Push the two connectors straight in.
6. Attach the alternator fan shield to the alternator, if so equipped.
7. Connect battery ground cable.

**DISASSEMBLY AND ASSEMBLY**

NOTE: All of the following Disassembly Steps may not be necessary to perform a particular test or service. Perform only those steps that apply. The following illustration is a disassembled view of the

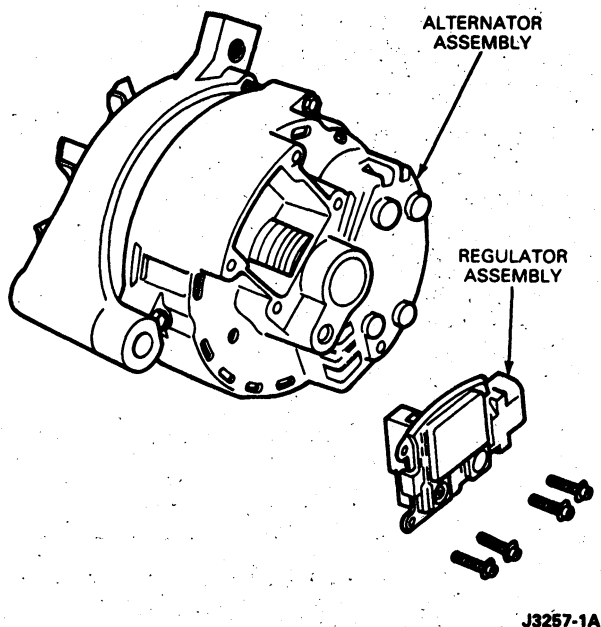
integral alternator/regulator assembly. On alternators with fan shield, remove attaching chip and then remove fan shield.



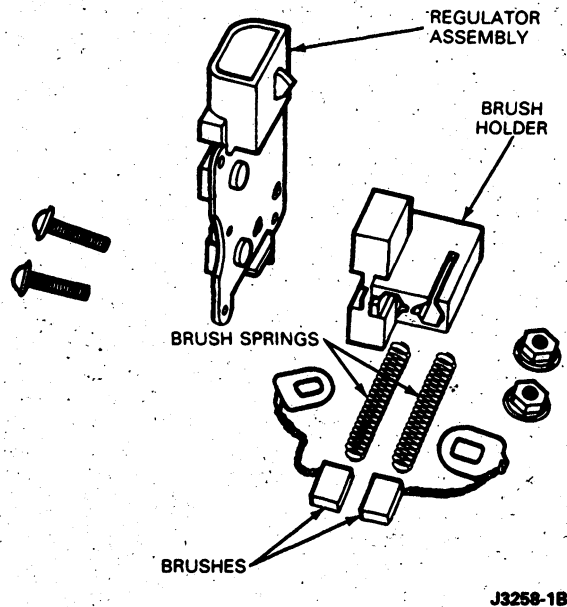
J3256-2B

**DISASSEMBLY AND ASSEMBLY (Continued)****Disassembly**

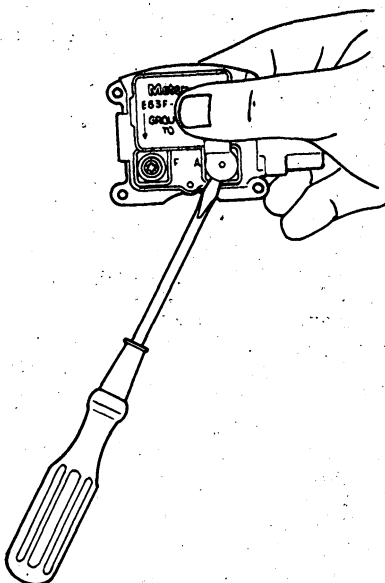
1. Remove the four screws (T20 TORX®-type head) attaching the regulator to the alternator rear housing. Remove the regulator, with brush holder attached, from the alternator.



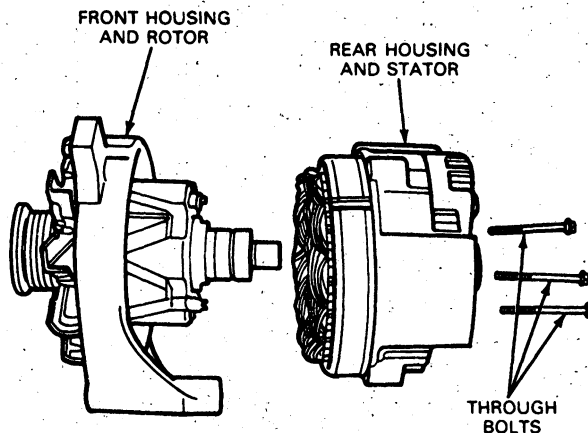
3. Remove two screws (T20 TORX®-type head) attaching the regulator to the brush holder. Separate the regulator, attaching nuts, brushes and brush springs from the brush holder.



2. Hold the regulator in one hand and break off the tab covering the "A" screw head with a screwdriver.



4. Scribe a line across the end housings and stator laminated core for reference during alternator assembly.
5. Remove the three through bolts.
6. Separate the front housing and rotor assembly from the stator and rear housing. It may be necessary to tap the front housing with a plastic tipped hammer to loosen the front housing from the stator core.

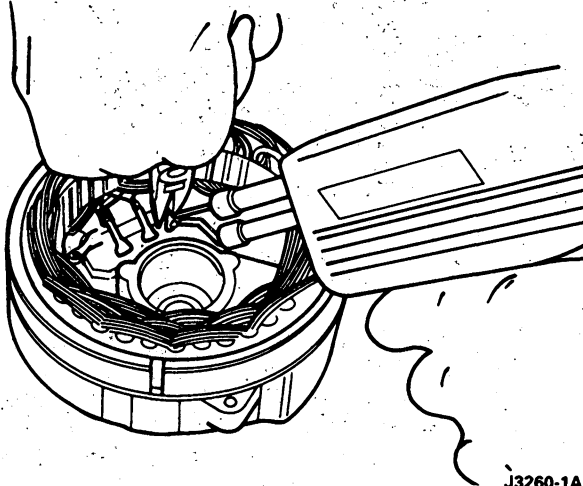


J3832-1A

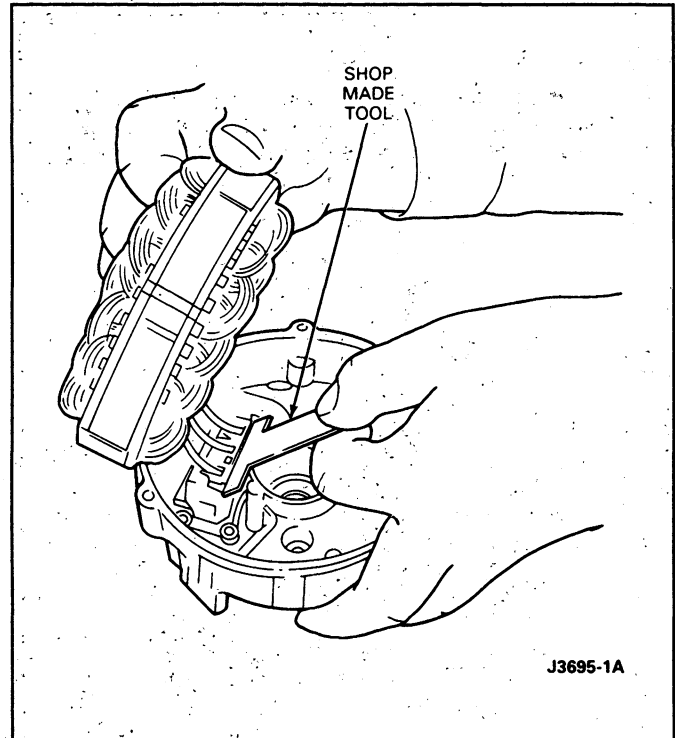
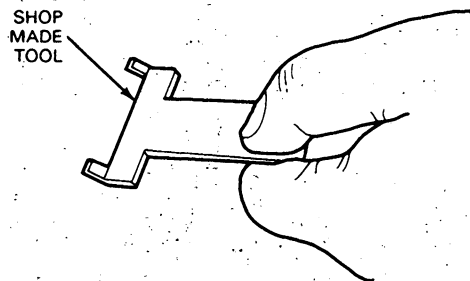
J3259-1A

**DISASSEMBLY AND ASSEMBLY (Continued)**

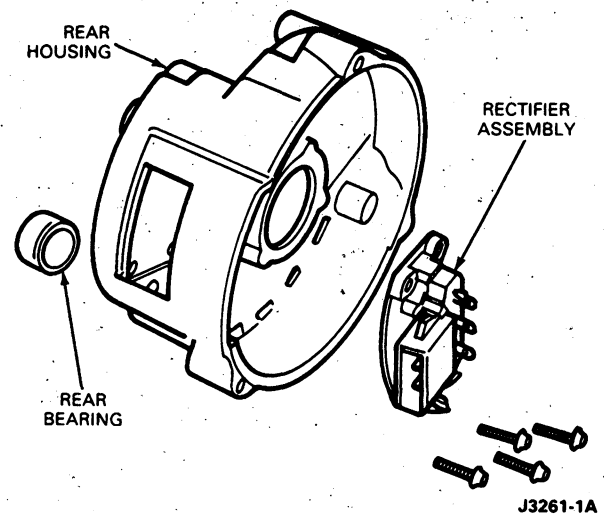
7. Remove the three stator lead terminals from the rectifier. If the terminals are soldered in place, unsolder the connections using a 100-watt soldering iron. Do not allow the soldering iron to overheat the rectifier. Use needlenose pliers to pull the stator lead terminals upward from the rectifier assembly. Separate the stator from the rear housing.



8. Some alternators are designed with a connector block. In these designs, the terminals are not soldered to the rectifier. Using a shop made tool, carefully pry the connector block straight up to avoid bending the terminals.

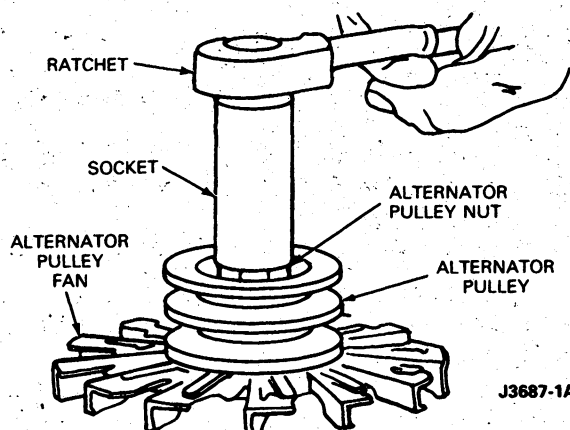


9. Remove the four rectifier assembly attaching screws (T20 TORX®-type head). Remove the rectifier assembly from the housing.
10. Using a suitable arbor press, remove the bearing from the rear housing. Support the housing close to the bearing boss to prevent housing damage.



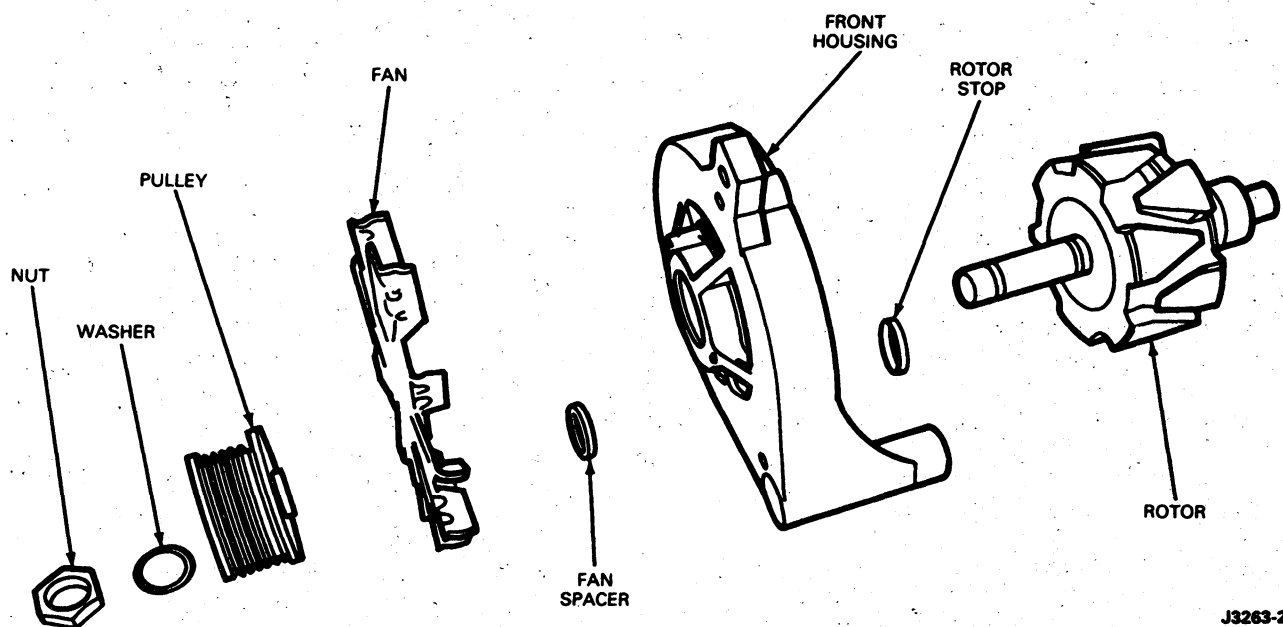
**DISASSEMBLY AND ASSEMBLY (Continued)**

11. Clamp the rotor in a soft jaw vise.
12. Remove the pulley nut with a socket wrench.



13. Remove the flatwasher, drive pulley, fan and fan spacer from the rotor shaft.
14. Remove the housing from the rotor and remove the rotor from the vise.
15. Remove the front rotor stop from the rotor shaft. Do not remove the stop ring from the rotor shaft unless it is damaged.

16. Remove the screws attaching the bearing retainer to the front housing and remove the retainer.
17. Remove the bearing from the front housing. If the bearing will not slide out, remove it using a suitable arbor press. Support the bearing close to the bearing boss to prevent damage to the housing.



**DISASSEMBLY AND ASSEMBLY (Continued)****Cleaning and Inspection**

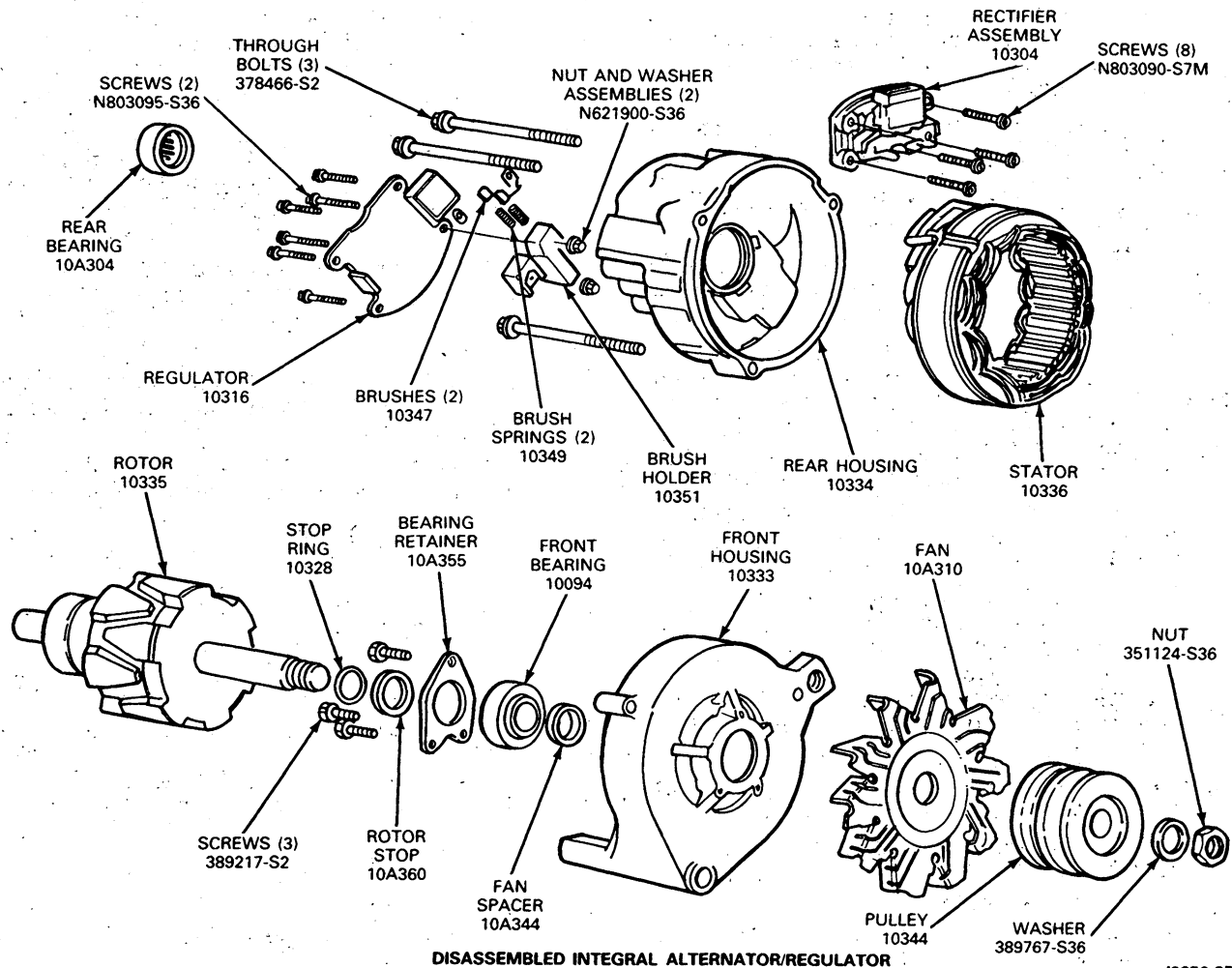
**CAUTION:** When rebuilding an integral alternator, use only high-temperature bearings. Use of standard parts will result in alternator failure.

1. Wipe the stator, rotor and front bearing with a clean cloth. Do not clean these parts with solvent.
2. Rotate the front bearing on the drive end of the rotor shaft. Check for any scraping noise, looseness or roughness. Look for excessive lubricant leakage. If any of these conditions exist, replace the bearing.
3. Inspect the rotor shaft rear bearing surface for roughness or severe chatter marks. Replace the rotor assembly if the shaft is not smooth.
4. Place the rear bearing on the slip ring end of the rotor shaft and rotate the bearing. Make the same check for noise, looseness and roughness as was made for the front bearing. Inspect the rollers and cage for damage. Replace the rear bearing if these conditions exist or if the lubricant is lost or contaminated.
5. Check the slip rings for nicks and scratches. These may be removed by turning down the slip rings. Do not go beyond a minimum diameter of 31mm (1.22 inches). If the rings are badly damaged, replace the rotor assembly.
6. Check all wire leads on both the rotor and stator assemblies for loose or broken connections. Check the windings for burned insulation. Replace parts that show signs of burned insulation.
7. Check the pulley and fan for excessive looseness on the rotor shaft and for cracks or other damage. Replace any pulley or fan that is loose, cracked or bent out of shape.
8. Check both the front and rear housings for cracks, particularly in the webbed areas at the mounting ear. Replace a damaged or cracked housing.
9. Wipe the heat transfer grease from the rectifier assembly base and rectifier mounting areas of the rear housing with a clean cloth.
10. Replace the brushes if they are worn shorter than 6.35mm (1/4 inch) from the shunt.

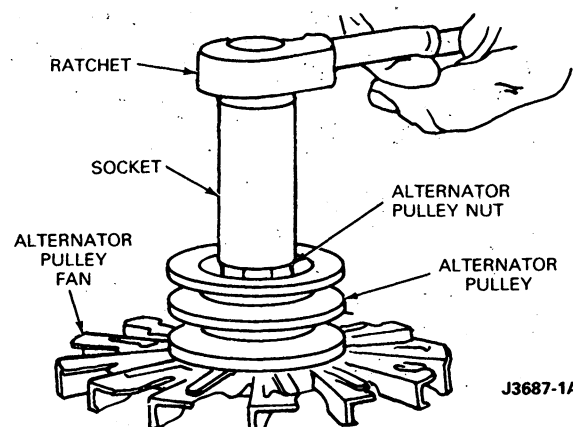
## DISASSEMBLY AND ASSEMBLY (Continued)

**Assembly**

Refer to the following illustration for Alternator/Regulator Assembly.



1. Install the bearing in the front housing. Press on the outer race only.
2. Position the bearing retainer on the front housing and install the attaching screws. Tighten the screws to 2.8-4.8 N·m (24-42 lb-in).
3. If the stop ring was removed from the rotor shaft, install a new ring by sliding it over the end of the shaft and into the groove furthest from the pole piece. Do not open the ring with snap ring pliers as permanent deformation of the ring will result.
4. Install the rotor stop on the rotor shaft with the recessed side against the stop ring.
5. Install the rotor in the front housing and clamp the rotor in a vise equipped with protective jaws.
6. Install the fan spacer, fan, drive pulley, flatwasher and nut on the rotor shaft. Tighten the nut to 82-135 N·m (60-100 lb-ft) with a socket wrench.



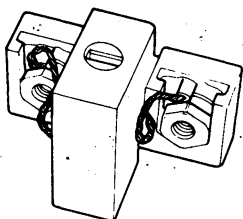


## DISASSEMBLY AND ASSEMBLY (Continued)

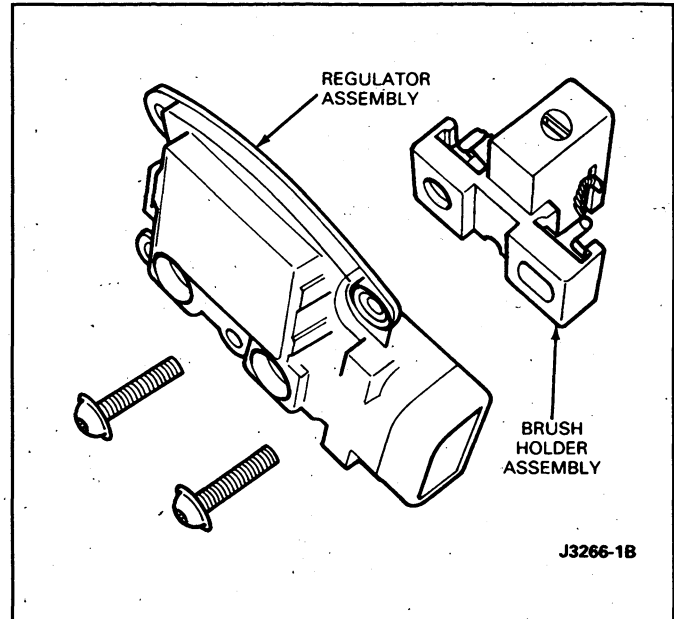
7. Remove the rotor and housing assembly from the vise and check for free rotation of the rotor in the housing.
8. Support the rear housing close to the bearing boss to prevent damage to the housing and install the bearing using a suitable arbor press. Press the bearing into the bore until it is flush with the outside rear surface of the housing.
9. Wipe the rectifier assembly base plate with a clean cloth. Apply a 2.0mm (3/32 inch) wide by 20mm (3/4 inch) long strip of Ford Heat Sink Compound ESF-M99G138-A or equivalent, lengthwise across the rectifier assembly base plate.
10. Wipe the rectifier mounting surface of the rear housing with a clean cloth and seat the rectifier into the recessed mounting area.

**CAUTION: The rectifier assembly is cooled by conducting rectifier heat directly into the rear housing. Failure to remove foreign material from the mounting surfaces or failure to apply heat sink compound may cause rectifier overheating.**

11. Install the four rectifier assembly attaching screws. Tighten the screws to 2.8-4.0 N·m (25-35 lb-in).
12. Position the stator assembly in the rear housing and align the scribe marks made during disassembly. Push the three stator terminals onto the rectifier blade terminals. Solder securely using resin core electrical solder if the terminals were previously soldered. Work quickly to prevent overheating the rectifier.
13. Wipe the rear end bearing surface of the rotor shaft with a clean, lint-free cloth.
14. Position the rear housing and stator assembly over the rotor and align the scribe marks made during disassembly.
15. Seat the machined portion of the stator core into the stop in both end housings and install the housing through bolts. Tighten the bolts to 4.1-6.7 N·m (35-60 lb-in). Spin the rotor to check for free movement.
16. Position the two nut and washer assemblies into the retaining slots in the brush holder. Tip the holder back slightly so that the nut and washer assemblies fall to the nut side of the slots. Insert the brush terminals past the washers and into the slots.

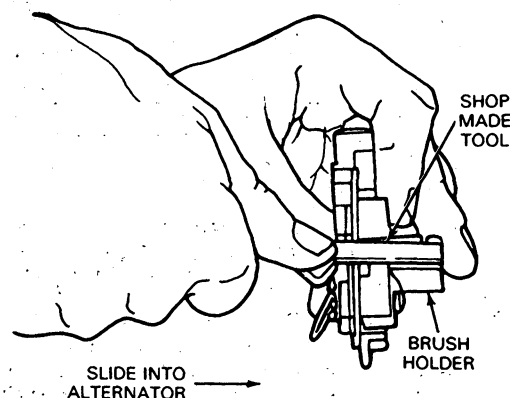


J3265-1A



J3266-1B

17. Wipe the regulator base plate with a clean cloth. Position the regulator against the brush holder and install the regulator to brush holder attaching screws. Tighten the screws to 2.3-3.4 N·m (20-30 lb-in).
18. Cover the head of the A terminal screw head with electrical tape.
19. Place brush springs in brush holder. Locate brushes in brush holder and hold in place with a thin, flat piece of steel (retaining tool). Loop the brush leads toward the brush end of the brush holder.



J3837-1A

20. Wipe the regulator mounting surface of the alternator rear housing with a clean cloth. Position the regulator and brush holder assembly in the alternator rear housing and pull the retaining tool.
21. Install the regulator attaching screws. Tighten the screws to 2.8-4.0 N·m (25-35 lb-in).

## SPECIFICATIONS

Supplier	Rating		Slip-Ring Turning				Brush Length				Pulley Nut	
	Amperes @ 15V	Watts @ 15V	Min. Diameter		Max. Runout		New		Wear Limit		N-m	Lb-Ft
			MM	Inches	MM	Inches	MM	Inches	MM	Inches		
Ford	40A	600W	31	1.22	.013	0.0005	12.19	.480	6.35	.25	82-135	60-100
Ford	40A HE	600W	31	1.22	.013	0.0005	12.19	.480	6.35	.25	82-135	60-100
Ford	60A	900W	31	1.22	.013	0.0005	12.19	.480	6.35	.25	82-135	60-100
Ford	65A	975W	31	1.22	.013	0.0005	12.19	.480	6.35	.25	82-135	60-100
Ford	75A	1125W	31	1.22	.013	0.0005	12.19	.480	6.35	.25	82-135	60-100

CJ3268-2B

Description	N-m	In-Lb
Pulley Nut	81-135	60-100 ①
Through Bolt	4.1-6.7	35-60
Rectifier Assembly Mounting Screw	2.8-4	25-35
Brush Holder Mounting Screw	2.3-3.4	20-30
Regulator Mounting Screw	2.8-4	25-35
Bearing Retainer Screw	2.8-4.5	24-42

① Ft-Lb

CJ3267-1B

## SPECIAL SERVICE TOOLS

## SPECIAL SERVICE TOOLS

Tool Number	Description
T63L-8620-A	Belt Tension Gauge
T65P-10300-B	Alternator Pulley Remover

CJ3270-1C

## ROTUNDA EQUIPMENT

Model	Description
021-00019	Belt Tension Gauge
059-00010	Dwell-Tach-Volt-Ohmmeter

CJ3281-1B

# SECTION 31-43 Alternator Electric Regulator

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION	
Ammeter Regulators .....	31-43-2	Electronic Regulator .....	31-43-4
Application .....	31-43-3	SPECIAL SERVICE TOOLS .....	31-43-4
Charge Indicator Lamp Regulators .....	31-43-1	VEHICLE APPLICATION .....	31-43-1

## VEHICLE APPLICATION

All Models

## DESCRIPTION AND OPERATION

The electrical charging system incorporates an electronic voltage regulator which is 100 percent solid-state, consisting of transistors, diodes, and resistors. The working functions are achieved using electronic components arranged in three basic circuit divisions as follows: the output stage, the voltage stage, and the solid-state relay. Some models also have an overcurrent protection circuit. Regulators marked "overcurrent protected" will automatically shut off if there is a short in the field circuit. When the problem is corrected the regulator will reset itself.

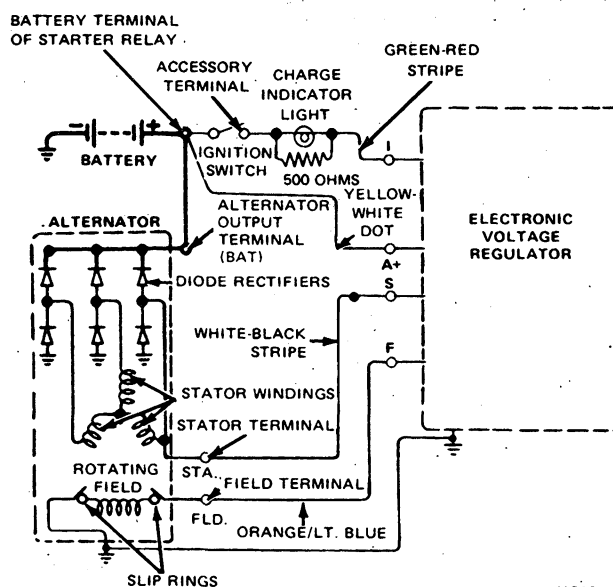
The production-installed regulator is released under two separate part numbers with color codes. The units look alike, but are not interchangeable with the regulator wiring harness connector plugs. The service part regulator is interchangeable between systems.

One of these units is used on vehicles equipped with an ammeter, the other on vehicles equipped with an alternator warning indicator lamp. The regulators are calibrated and preset by the manufacturer. No adjustment is required or possible on these units.

## Charge Indicator Lamp Regulators

Closing the ignition switch energizes the warning lamp and turns on the regulator output stage. The alternator is now receiving maximum field current and is ready to generate an output voltage. Once the alternator rotor speed increases from zero, its output and stator terminal voltages increase from zero to system regulation level determined by regulator setting.

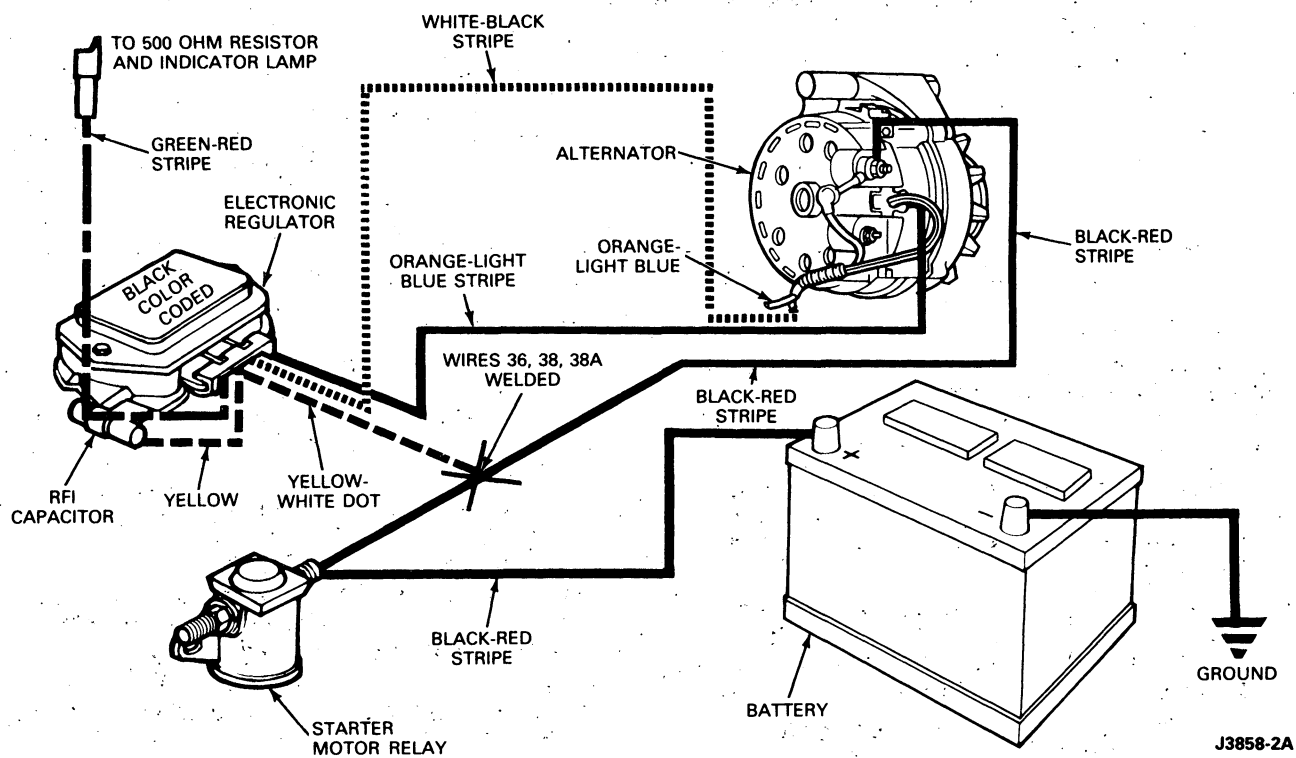
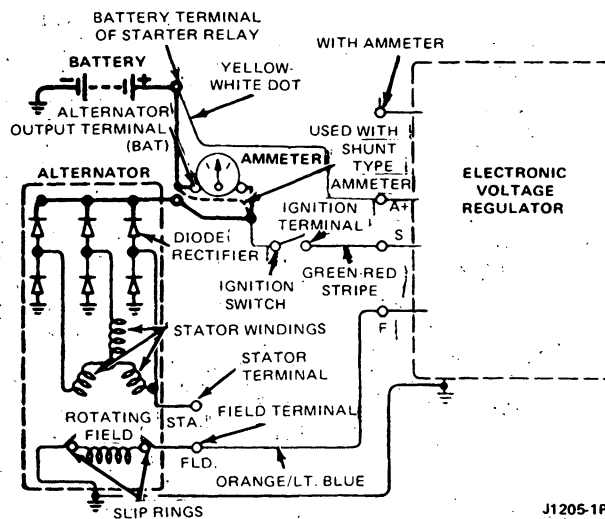
When the ignition switch is turned to OFF, the solid-state relay circuit causes the output stage to be turned off, interrupting all current flow through the regulator so that there is no stand-by current drain on the battery.



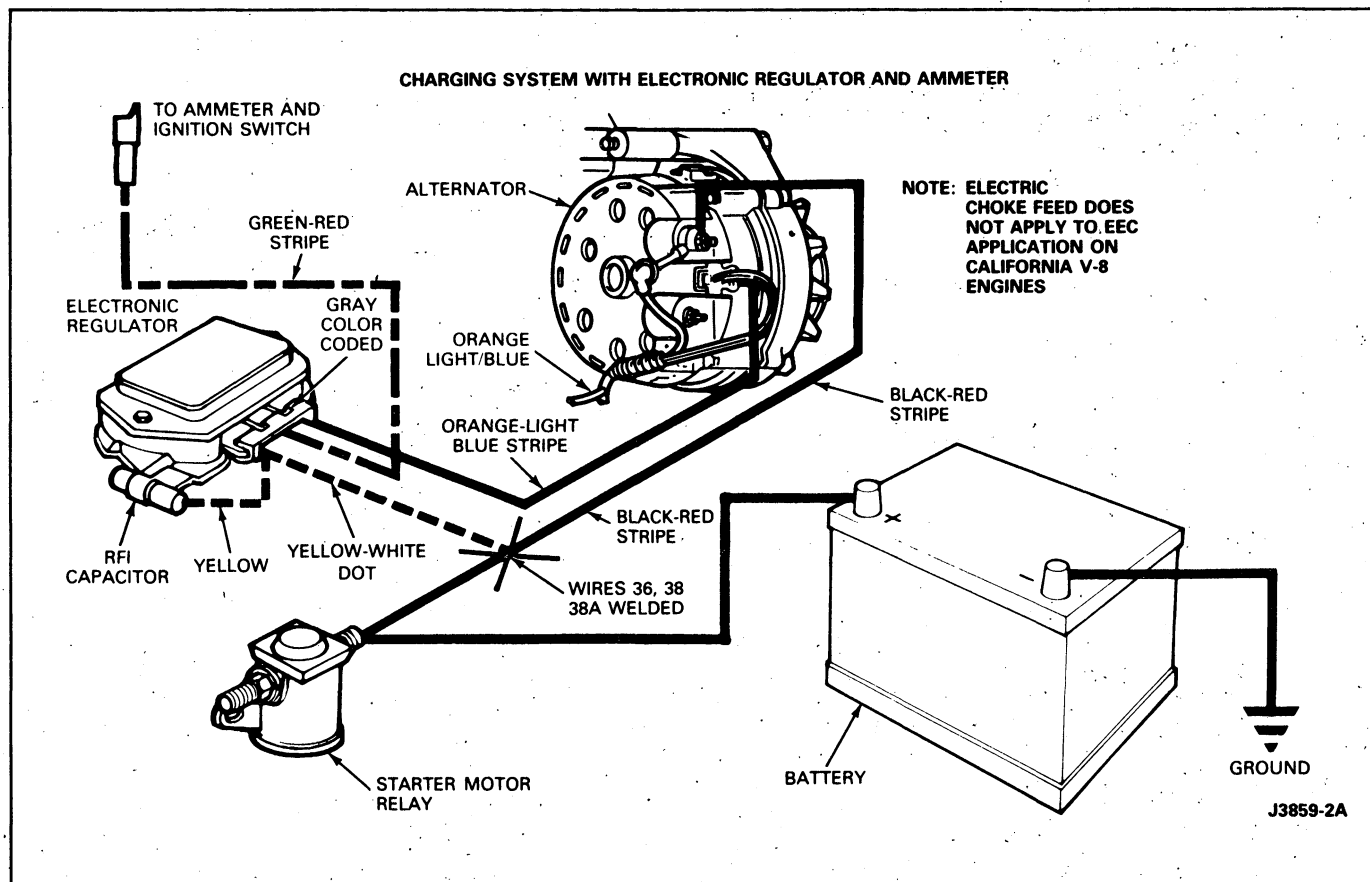
## DESCRIPTION AND OPERATION (Continued)

## Ammeter Regulators

The operating principle for the regulator used in ammeter-equipped vehicles is much the same as the indicator lamp type.



## DESCRIPTION AND OPERATION (Continued)

**Application**

Whenever the system components are being replaced, the following precautions should be followed so that the charging system will work properly and components will not be damaged.

1. Always use the proper alternator in the system being serviced. Older model alternators, if used in the present system, will have a slightly reduced output.
2. Never use an electromechanical regulator in the new charging system. The connector plug on the new system wiring harness will not index properly with the electromechanical regulator.
3. The electronic regulator connector plugs are color coded for proper installation. Always use the black color coded regulator in systems which use the warning lamp indicator. The gray color coded regulators must be used in ammeter gauge systems. The clear coded regulators are service parts and may be used in either system.
4. The charging system uses a 500-ohm resistor on the back of the instrument cluster on trucks with warning indicator lamp. Do not replace this item with the 15-ohm resistance wire.

**Visual Inspections**

1. Check battery for at least 12.48 volts using Rotunda Battery Tester 041-00002 or equivalent. Check and clean all terminal connections at battery, alternator, and regulator.
2. Check alternator drive belt for proper tension using Belt Tension Gauges T63L-8620-A, Rotunda 021-00019 or equivalent.

**CAUTION: Ensure field terminal connector is installed on the "field" terminal stud at alternator and not the ground stud.**

Always disconnect the connector plug from the regulator before checking alternator output with test probes or a jumper wire.

Always disconnect the connector plug from the regulator before removing the regulator mounting screws. Removing the connector from an ungrounded regulator with the ignition switch in RUN will destroy the regulator.

Be sure to disconnect electric choke wire from stator terminal at alternator when trouble-shooting charging system. Check electric choke wire for a ground condition.

Never attempt to polarize or test the alternator by grounding the field circuit, as this will destroy the regulator. (Overcurrent-protected regulators will be temporarily inactivated, until field ground is eliminated.

**REMOVAL AND INSTALLATION****Electronic Regulator****Removal**

1. Disconnect the battery ground cable.
2. Remove regulator mounting screws.
3. Disconnect regulator from wiring harness.

**Installation**

1. Mount new regulator
2. Connect new regulator to wiring harness.
3. Connect battery ground cable.
4. Test the system for proper voltage regulation.

**SPECIAL SERVICE TOOLS****SPECIAL SERVICE TOOL**

Number	Description
T63L-8620-A	Belt Tension Gauge

CA5760-1F

**ROTUNDA EQUIPMENT**

Number	Description
021-00019	Belt Tension Gauge
041-00002	Battery Tester

CA7332-1D

# LIGHTING SYSTEM

# GROUP 32

(13000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
TURN SIGNAL AND HAZARD WARNING FLASHERS .....	32-41-1	INTERIOR LAMPS .....	32-61-1
HEADLAMP SYSTEM .....	32-03-1	LIGHTING SYSTEM GENERAL SERVICE .....	32-01-1
		PARKING, REAR AND MARKER LAMPS .....	32-21-1

## SECTION 32-01 Lighting System General Service

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION .....	32-01-1	DIAGNOSIS AND TESTING (Cont'd)	
DIAGNOSIS AND TESTING		Testing Guide .....	32-01-5
Diagnosis Guides .....	32-01-1	VEHICLE APPLICATION .....	32-01-1

### VEHICLE APPLICATION

All E-150—E-350, F-150—F-350 and F-Super Duty Models.

### DESCRIPTION AND OPERATION

The lighting system includes the front headlamps (Section 32-03); the parking, rear, license, and marker lamps (Section 32-21); the turn signal and hazard flasher (Section 32-41); and the interior lamps (Section 32-61).

### DIAGNOSIS AND TESTING

Before performing any lighting system tests, ensure the battery is in a fully charged condition and all battery cable connections are clean and tight.

A visual inspection is an important part of the lighting system test. Check for wires with frayed or damaged insulation, loose connections and proper harness routing. Refer to the Truck Wiring Diagrams Manual.

Any problems found by the visual inspection should be corrected before performing further tests of the lighting system.

For example, a loose ground strap between the engine and body dash panel may cause an intermittent operation of the lamps and gauges. Inspect and tighten, if necessary, the ground strap attaching screws at the back of the engine and the body dash panel. If a No. 10 screw is required, use Part No. 42367-S36 hex washer head tapping screw.

NOTE: Any screws or bolts used for attaching the engine-to-body ground strap must have an "S36" finish (zinc plate-plus dichromate dip).

### Diagnosis Guides

The following Diagnosis Guides provide steps to take when trying to isolate lighting system problems.

Check for burned out bulbs or fuses before proceeding and replace as necessary.

NOTE: All Models use headlamp switch with circuit breaker for headlamps only. All other lamps are on-a fuse.

Refer to Testing Guide to verify headlamp switch continuity and condition.

CONDITION	POSSIBLE CAUSE	RESOLUTION
<b>HEADLAMPS</b> All exterior lamps do not light.	<ol style="list-style-type: none"> <li>1. Loose wiring connections.</li> <li>2. Open circuit in wiring.</li> <li>3. Bad ground.</li> <li>4. Worn or damaged headlamp switch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and secure connections at headlamp switch and dash panel connector.</li> <li>2. Check power to and from headlamp switch. Repair as necessary.</li> <li>3. Check ground circuit from bulbs.</li> <li>4. Verify condition. Replace headlamp switch if necessary.</li> </ol>
One headlamp does not work.	<ol style="list-style-type: none"> <li>1. Loose wiring connections.</li> <li>2. Sealed beam bulb burned out.</li> <li>3. Corroded socket.</li> </ol>	<ol style="list-style-type: none"> <li>1. Secure connections to headlamp and ground.</li> <li>2. Replace sealed beam.</li> <li>3. Repair or replace as required.</li> </ol>
All headlamps out — park and taillamps OK.	<ol style="list-style-type: none"> <li>1. Loose wiring connections.</li> <li>2. Worn or damaged dimmer switch.</li> <li>3. Worn or damaged headlamp switch.</li> <li>4. Open circuit in wiring or poor ground.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and secure connections at dimmer switch and headlamp switch.</li> <li>2. Check dimmer switch operation. Inspect for corroded connector. Replace as required.</li> <li>3. Verify condition. Replace headlamp switch if necessary.</li> <li>4. Repair as required.</li> </ol>
Both low beam or both high beam headlamps do not work.	<ol style="list-style-type: none"> <li>1. Loose wiring connections.</li> <li>2. Worn or damaged dimmer switch.</li> <li>3. Open circuit in wiring.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and secure connection at dimmer switch and headlamp switch.</li> <li>2. Check dimmer switch operation. Inspect for corroded connector. Replace as required.</li> <li>3. Repair as required.</li> </ol>
<b>TAILLAMPS</b> One taillamp out.	<ol style="list-style-type: none"> <li>1. Bulb burned out.</li> <li>2. Open wiring or poor ground.</li> <li>3. Corroded bulb socket.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace bulb.</li> <li>2. Repair as necessary.</li> <li>3. Repair or replace socket.</li> </ol>
All taillamps and marker lamps out — headlamps OK.	<ol style="list-style-type: none"> <li>1. Loose wiring connections.</li> <li>2. Open wiring or poor ground.</li> <li>3. Blown fuse.</li> <li>4. Damaged headlamp switch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Secure wiring connections where accessible.</li> <li>2. Check operation of front park and marker lamps. Repair as necessary.</li> <li>3. Replace if blown.</li> <li>4. Verify condition. Replace headlamp switch if necessary.</li> </ol>
<b>STOPLAMPS</b> Stoplamps do not work.	<ol style="list-style-type: none"> <li>1. Fuse or circuit breaker (C.B.) burned out.</li> <li>2. Worn or damaged turn signal circuit.</li> <li>3. Loose wiring connections.</li> <li>4. Worn or damaged stoplamp switch.</li> <li>5. Open circuit in wiring.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Section 34-31.)</li> <li>2. Check turn signal operation. Repair as necessary.</li> <li>3. Secure connection at stoplamp switch.</li> <li>4. Replace stoplamp switch.</li> <li>5. Repair as required.</li> </ol>

CK3898-2H



CONDITION	POSSIBLE CAUSE	RESOLUTION
<b>STOPLAMPS (Cont'd.)</b> Stoplamps stay on continuously.	1. Damaged stoplamp switch.  2. Internal short circuit in wiring.	1. Disconnect wiring connector from switch. If lamp goes out, replace switch.  2. If lamp stays on, check for internal short circuit. Repair as necessary.
<b>PARKING LAMPS</b> One parking lamp out.	1. Bulb burned out. 2. Open wiring or poor ground. 3. Corroded bulb socket.	1. Replace bulb. 2. Repair as necessary. 3. Repair or replace socket.
All parking lamps out.	1. Loose wiring connections. 2. Open wiring or poor ground. 3. Bulbs burned out.	1. Secure wiring connections. 2. Repair as necessary. 3. Replace bulbs.
<b>SIDE OR ROOF MARKER LAMPS</b> Side or roof marker lamp does not light.	1. Bulb burned out. 2. Open circuit or poor ground.	1. Replace bulb. 2. Check socket for corrosion and good ground. Repair as required.
<b>TURN SIGNAL LAMPS</b> All turn signal lamps do not light.	1. Fuse or C.B. burned out.  2. Worn or damaged turn signal flasher. 3. Loose wiring connections. 4. Open circuit in wiring or poor ground. 5. Damaged turn signal switch.	1. Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Section 34-31.)  2. Substitute a known good flasher. Replace if required. 3. Secure connections where accessible. 4. Repair as required. 5. Check continuity of switch assembly. Replace turn signal switch and wiring assembly if necessary.
Turn signal lamps light but do not flash.	1. Worn or damaged turn signal flasher. 2. Poor ground.	1. Substitute a known good flasher. Replace if required. 2. Repair ground.
Front turn signal lamps do not light.	1. Loose wiring connector or open circuit.	1. Repair wiring as required.
Rear turn signal lamps do not light.	1. Loose wiring connector or open circuit.	1. Repair wiring as required.
One turn signal lamp does not light.	1. Bulb burned out. 2. Open circuit in wiring or poor ground.	1. Replace bulb. 2. Repair as required.
<b>LICENSE LAMPS</b> One license lamp does not light.	1. Bulb burned out. 2. Open circuit in wiring.	1. Replace bulb. 2. Repair as required.
All license lamps do not light.	1. Bulbs burned out. 2. Open circuit in wiring or poor ground. 3. Damaged headlamp switch.	1. Replace bulbs. 2. Repair wiring as required. 3. Replace switch.

CK6729-2D

CONDITION	POSSIBLE CAUSE	RESOLUTION
<b>HAZARD FLASHER LAMPS</b> Hazard flasher lamps — do not flash.	1. Fuse or C.B. burned out. 2. Worn or damaged hazard flasher. 3. Worn or damaged turn signal operation. 4. Open circuit in wiring. 5. Worn or damaged hazard flasher switch.	1. Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Section 34-31.) 2. Substitute a known good flasher. Replace flasher if damaged. 3. Repair turn signal system. 4. Repair as required. 5. Repair or replace the turn signal switch and wiring assembly which includes the hazard flasher switch.
<b>BACKUP LAMPS</b> Backup lamps — one lamp does not function.	1. Bulb burned out. 2. Loose wiring connections. 3. Open circuit in wiring.	1. Replace bulb. 2. Secure connections where accessible. 3. Repair as required.
Backup lamps — both lamps do not function.	1. Fuse or C.B. burned out. 2. Backup lamp switch out of adjustment. 3. Worn or damaged backup lamp switch. 4. Loose wiring connections. 5. Open wiring or poor ground. 6. Bulbs burned out.	1. Replace fuse or C.B. If fuse or C.B. blows again, check for short circuit. (See Section 34-31.) 2. Adjust switch. 3. Replace switch. 4. Secure connections where accessible. 5. Repair as required. 6. Replace bulb.
<b>INSTRUMENT PANEL LAMP(S)</b> Instrument panel lamp does not light.	1. Bulb burned out. 2. Fuse burned out. 3. Open circuit in wiring, rheostat or printed circuit board.	1. Replace bulb. 2. Replace fuse. If fuse blows again, (See Section 34-31). 3. Check for a short circuit. Repair as required.
<b>DOME LAMP</b> Dome lamp does not come on when door is opened.	1. Connector loose. 2. Blown fuse. 3. Bulb burned out. 4. Open circuit in wiring. 5. Worn or damaged door jamb switch.	1. Secure and/or replace. 2. Replace fuse. If fuse blows again, check for short circuit. (See Section 34-31.) 3. Replace bulb. 4. Repair as required. 5. Replace door jamb switch.
Dome lamp stays on.	1. Worn or damaged door jamb switch. 2. Worn or damaged main lighting switch.	1. Replace switch. 2. Replace main lighting switch.
<b>PRND21 LIGHTING</b> Poor PRND21 lighting.	1. Burned out bulb. 2. Weak bulb. 3. Wiring. 4. Worn or damaged dial. 5. Worn or damaged pointer. 6. Paint overspray.	1. Replace bulb. 2. Replace bulb. 3. Check wiring for high resistance. If resistance is high, repair or replace as required. 4. Check for total lens illumination. Replace dial if necessary. 5. Check for pointer illumination at all dial positions. Replace pointer if necessary. 6. Replace dial.
<b>MAP/DOME LAMP (RPO)</b> Map lamp does not come on when switch is actuated.	1. Bulb burned out. 2. Blown fuse. 3. Open circuit in wiring. 4. Worn or damaged switch in lamp assembly.	1. Replace bulb. 2. Replace fuse. 3. Repair as required. 4. Replace lamp assembly.
Map lamp stays on.	1. Worn or damaged switch in lamp assembly.	1. Replace lamp assembly.

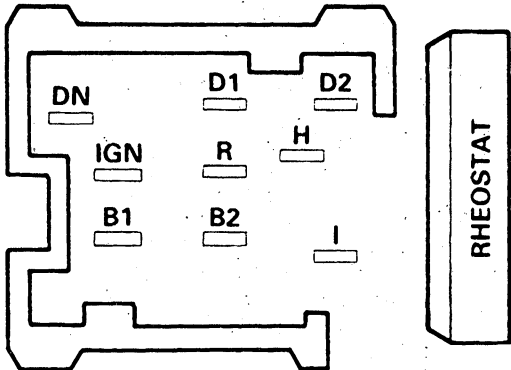
CK3899-2F

## Testing Guide

### Headlamp Switch

The following test provides a continuity check for the headlamp switch to verify switch condition. If the switch fails to show continuity as indicated in the test, replace switch.

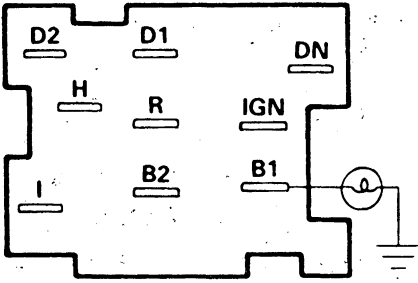
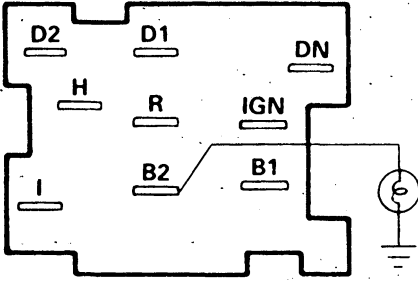
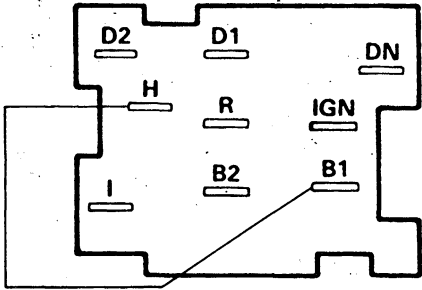
#### HEADLAMP SWITCH — BENCH CHECK CONTINUITY

		<b>CONNECTOR 11A646</b> <ul style="list-style-type: none"> <li>• Terminal DN — Daytime Illumination</li> <li>• Terminal IGN — DN Feed</li> <li>• Terminal B1 — Headlamp Feed</li> <li>• Terminal B2 — Park/Rear/Instrument Panel Lights Feed</li> <li>• Terminal D1 — Dome Lamp Feed</li> <li>• Terminal D2 — To Dome Lamp</li> <li>• Terminal H — To Headlamps</li> <li>• Terminal R — To Parking/Rear Lamps</li> <li>• Terminal I — To Instrument Panel Lamps</li> <li>• Rheostat — Provides variable resistance between Terminals R and I</li> </ul>
SWITCH POSITION	CIRCUIT CONTINUITY	
Daytime Illumination <ul style="list-style-type: none"> <li>• Ignition Switch ON</li> <li>• Headlamp Switch OFF</li> </ul>	Closed Circuit — IGN Terminal to DN Terminal	
Parking/Rear Lamps <ul style="list-style-type: none"> <li>• Headlamp Switch ON — first stop position</li> </ul>	Closed Circuit — DN Terminal to I Terminal B2 Terminal to R Terminal	
Headlamps <ul style="list-style-type: none"> <li>• Headlamp Switch ON — second stop position</li> </ul>	Closed Circuit — DN Terminal to I Terminal B2 Terminal to R Terminal B1 Terminal to H Terminal	
Instrument Panel Illumination <ul style="list-style-type: none"> <li>• ROTATE Headlamp Switch Knob</li> </ul>	Variable Resistance — Between Terminal R and Terminal I	

CK10144-2B

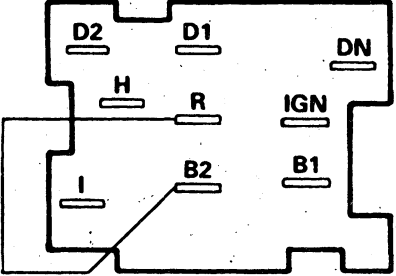
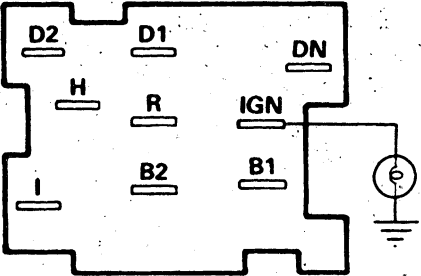
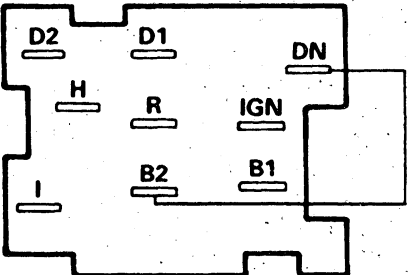
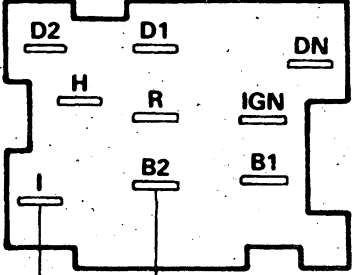
## HEADLAMP SWITCH CONNECTOR CHECKOUT

1. Replace burned out bulbs and fuses before proceeding.
2. A 12-volt test lamp and jumper wire will be required.
3. When necessary to trace and/or service the various circuits, refer to the respective vehicle wiring diagrams.
4. Terminal identification used on connector checkout procedure corresponds with actual identification on headlamp switch.
5. Perform checks in sequence as shown.

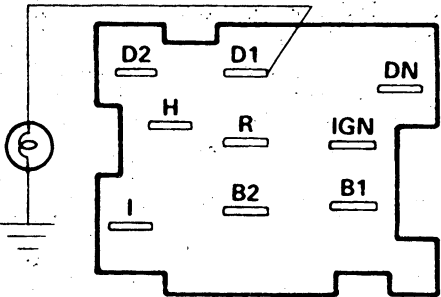
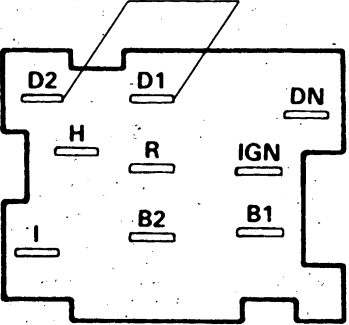
OPERATION	RESULT
<p><b>1</b> Connect a 12-volt test lamp between Terminal B1 and a good ground.</p> 	<p>Test lamp should light. If not, trace circuit back to fuse link and service as necessary.</p>
<p><b>2</b> Connect a 12-Volt test lamp between Terminal B2 and a good ground.</p> 	<p>Test lamp should light. If not, trace circuit back to fuse panel and service as necessary.</p>
<p><b>3</b> Connect a jumper wire between Terminals B1 and H.</p> 	<p>Headlamps should light. If not, trace Circuit H back to headlamps and service. If circuit is OK, check ground circuit from headlamps to ground.</p>

CK10441-2A

## HEADLAMP SWITCH CONNECTOR CHECKOUT — Continued

OPERATION	RESULT
<p><b>4</b> Connect a jumper wire between Terminals B2 and R.</p> 	<p>Parking lamps, rear lamps, and marker lamps should light. If not, trace Circuit R and service as necessary. If Circuit R is OK, check ground circuit from lamps to ground.</p>
<p><b>5</b> Connect a 12-volt test lamp between Terminal IGN and a good ground.</p> 	<p>With ignition switch in the RUN position, the test lamp should light. If not, trace circuit back to ignition switch and service as necessary.</p>
<p><b>6</b> Connect a jumper wire between Terminals B2 and DN.</p> 	<p>Liquid crystal display lamps only, should come on, full bright. If lamps do not light, trace Circuit DN back to lamps and service as necessary. If Circuit is OK, check ground circuit from lamps to ground.</p> <p>NOTE: No other instrument panel lamps will light during this test.</p>
<p><b>7</b> Connect a jumper wire between Terminals B2 and I.</p> 	<p>Instrument panel illumination lamps only, should come on, full bright. If panel lamps do not light, trace I circuit back to lamps and service as necessary. If circuit is OK, check ground circuit from lamps to ground.</p> <p>NOTE: Liquid crystal displays will not light during this test.</p>

CK10442-2C

OPERATION	RESULT
<p><b>8</b> Connect a 12-volt test lamp between Terminal D1 and a good ground.</p> 	<p>Test lamp should light. If not, trace circuit back to fuse panel and service as necessary.</p>
<p><b>9</b> Connect a jumper wire between Terminals D1 and D2.</p> 	<p>With all vehicle doors closed, dome lamp should light. If not, trace circuit D2 back to dome lamp and service as necessary. If circuit is OK, check ground circuit from dome lamp to ground.</p>

CK10443-2B

# SECTION 32-03 Headlamp System

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Headlamp Aim .....	32-03-1	Headlamp Bulb—F-150—F-350 and Bronco .....	32-03-2
<b>DESCRIPTION AND OPERATION</b>		Headlamp Switch .....	32-03-3
Headlamp Switch .....	32-03-1	E-150—E-350 .....	32-03-3
Headlamps E-150—E-350 .....	32-03-1	F-150—F-350 and Bronco .....	32-03-3
Headlamps On Warning Buzzer .....	32-03-1	<b>SPECIAL SERVICE TOOLS</b> .....	32-03-7
<b>REMOVAL AND INSTALLATION</b>		<b>VEHICLE APPLICATION</b> .....	32-03-1
Dimmer Switch .....	32-03-4		
Headlamp Bulb E-150—E-350 .....	32-03-3		

## VEHICLE APPLICATION

All Light Truck Models.

## DESCRIPTION AND OPERATION

### Headlamps E-150—E-350

Two type 2B rectangular headlamps are used. The lamps have two filaments each, one for low beam and one for high beam. The filaments are identified by the numeral 2 or 2B molded into the glass lens. Headlamps are controlled by the headlamp switch on the instrument panel and the foot-operated dimmer switch on the floor to the left of the clutch/brake pedal.

### Headlamps—F-150—F-350 and Bronco

Two aerodynamically styled headlamps are used. Each lamp uses a halogen bulb. A burned out bulb may be replaced without removing the headlamp. Headlamps are controlled by the headlamp switch on the instrument panel and the foot-operated dimmer switch on the floor to the left of the clutch/brake pedal.

### Headlamp Switch

The headlamp switch (Fig. 1) is a combination, three-position switch that controls the circuits to the headlamps, exterior lamps (except stoplamps and turn signal/hazard warning lamps), instrument panel lamps and other interior lamps. A typical headlamp switch is shown in Fig. 1. Circuits are connected to the switch by a molded multiconnector.

The interior lamp circuit is routed through a rheostat on the switch, which is controlled by rotating the switch control knob. This circuit is protected by a fuse in the fuse panel.

NOTE: Refer to Section 32-01, Lighting System General Service, for diagnosis and testing of headlamp switch.

### Headlamps On Warning Buzzer

With optional Headlamps On Warning, a seven-terminal buzzer replaces the six-terminal buzzer used with Key Warning. This buzzer allows dual function of the Key Warning and Headlamps On Warning buzzers. The seventh terminal is connected to the taillamp circuit (circuit No. 14); otherwise the circuits are identical. As in Key Warning, when the door is opened, circuit No. 159 is energized and if the headlamp switch is operated, a transistor is turned on to allow completion of the buzzer

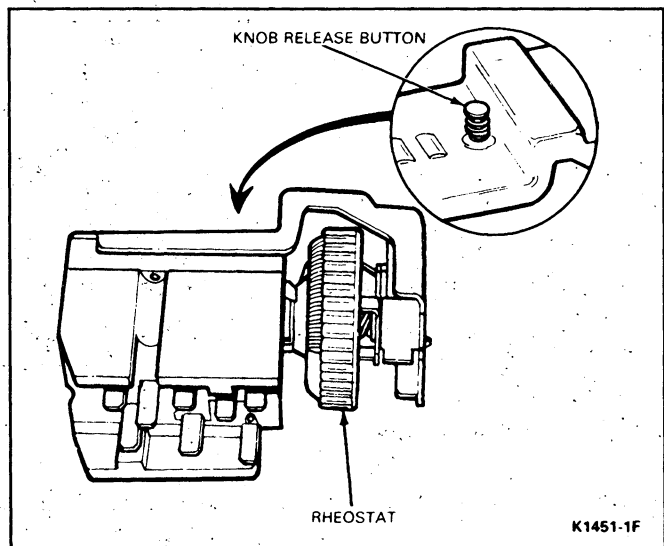


FIG. 1 Typical Headlamp Switch

ground path (circuit No. 57). The buzzer will continue to operate until either the headlamp switch is turned off or the driver's door is closed (Fig. 2). The buzzer is located on the RH side of the instrument panel above the glove compartment on F-150—F-350 and Bronco and to the LH side of the steering column on Econoline.

## ADJUSTMENTS

### Headlamp Aim

Before making any headlamp adjustments, perform the following preparatory steps:

1. Remove ice or mud from under fenders.
2. Verify that all tires are inflated to recommended pressures.
3. Check springs for sag or broken leaves.
4. Take into consideration faulty wheel alignment or improper tracking of the rear axle.
5. Verify there is no load in the vehicle other than the fuel tank one-half full.
6. Clean lenses and aiming pads.
7. Check for bulb burn-out and proper beam switching.

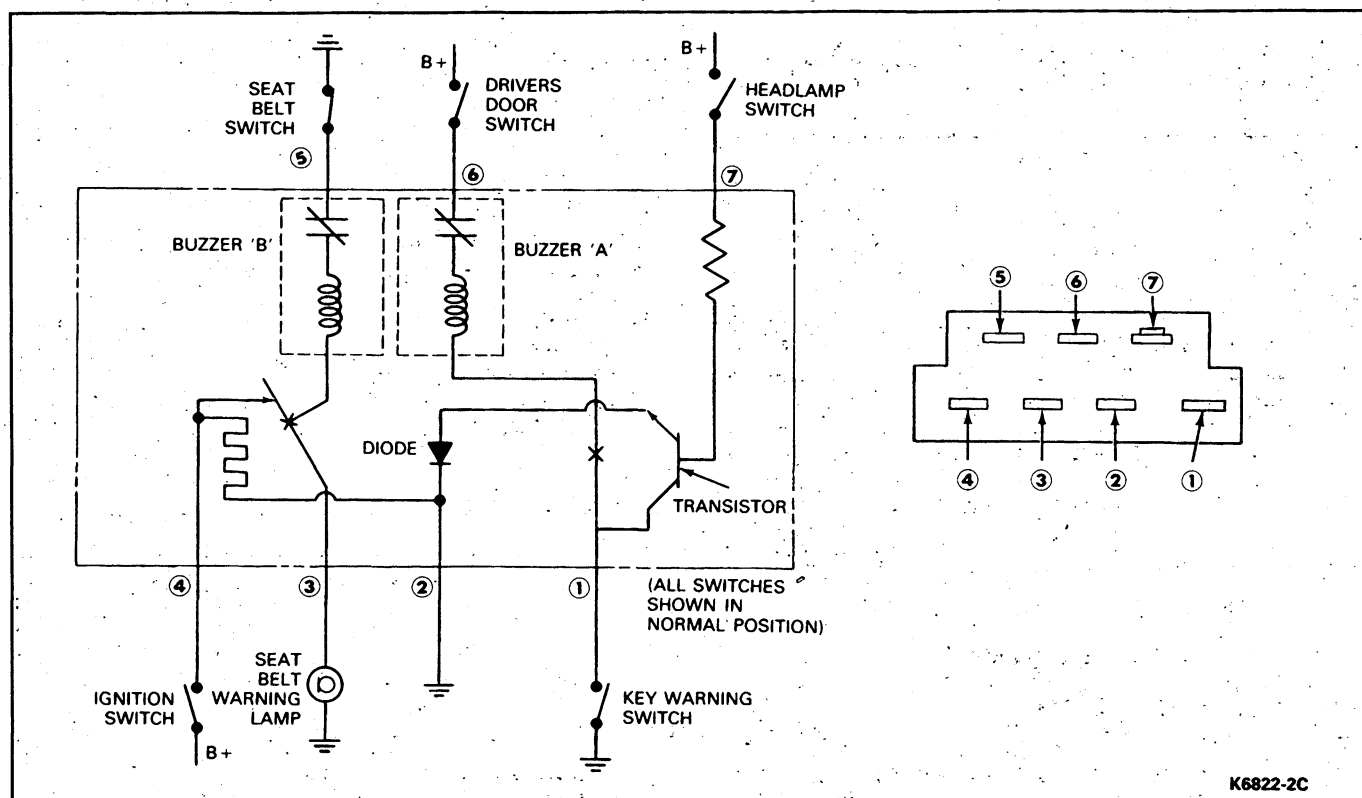


FIG. 2 Lamps-On Warning Buzzer and Wiring Diagram

8. Verify that lamp output is well toward normal new lamp value.
9. Bounce the vehicle and allow to settle.

Perform headlamp aim adjustments with Rotunda Headlamp Aiming Kit 107-00001, or equivalent. To aim the aerodynamically styled headlamps, the adjustable aimer adapters provided in the kit must be used. Adjustment aimer adapter positions are moulded into the bottom edge of the headlamp lens.

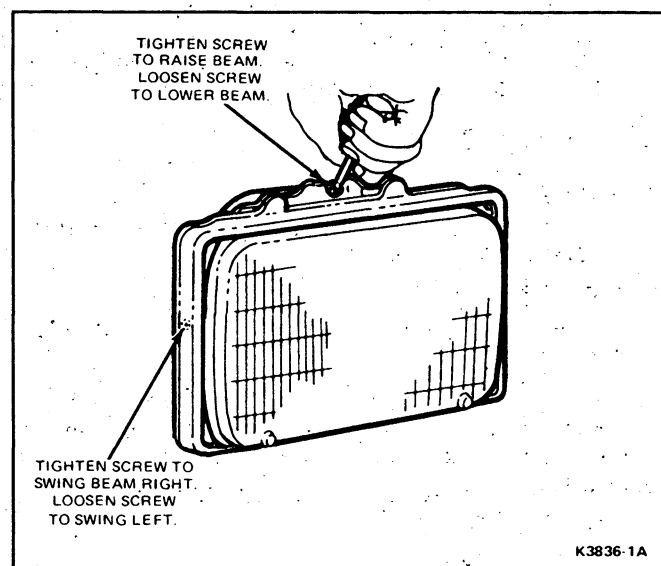


FIG. 3 Headlamp Adjustment Shown Without Headlamp Door or Trim Ring E-150—E-350

Set and lock the adjustable adapters, attach each adapter to its mechanical aimer, and aim headlamps per latest instructions in the kit.

The equipment in Rotunda Headlamp Aiming Kit 107-00001 or equivalent can be calibrated to accommodate a slight slope in the floor, making it usable almost any place in the garage. However, area must be reasonably flat.

Each headlamp is adjusted by means of two screws located under the headlamp door or trim ring as shown in Fig. 3.

NOTE: Access doors are provided to allow headlamp adjustment without removing the headlamp door.

Always bring each beam into final position by turning the adjusting screws clockwise so that the headlamp will be held against the tension springs when the operation is completed.

## REMOVAL AND INSTALLATION

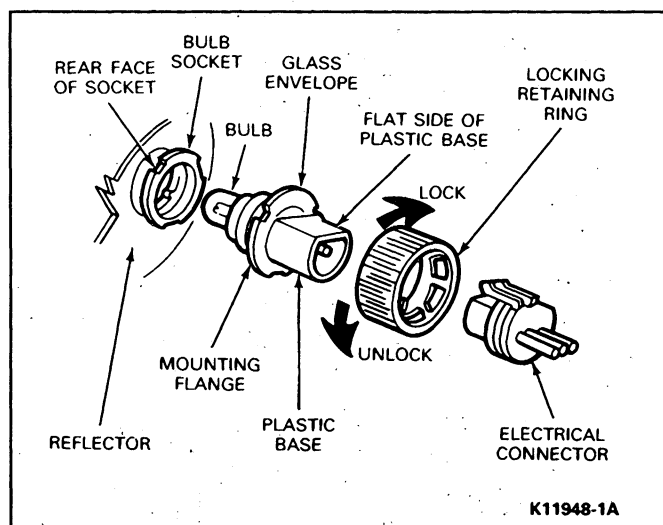
### Headlamp Bulb—F-150—F-350 and Bronco

#### Removal

**WARNING—THE HALOGEN HEADLAMP BULB CONTAINS GAS UNDER PRESSURE. THE BULB MAY SHATTER IF THE GLASS ENVELOPE IS SCRATCHED OR THE BULB IS DROPPED. HANDLE BULB CAREFULLY. GRASP BULB ONLY BY ITS PLASTIC BASE. AVOID TOUCHING THE GLASS ENVELOPE. KEEP BULB OUT OF REACH OF CHILDREN. ENERGIZE THE BULB ONLY WHEN INSTALLED IN THE HEADLAMP.**

1. Check that headlamp switch is in OFF position.
2. Lift hood and locate bulb installed in rear of headlamp body (Figs 4 and 5).





**FIG. 4 Bulb Removal and Installation—F-150—F-350 and Bronco**

3. Remove electrical connector from bulb by grasping wires firmly and snapping connector rearward.
4. Remove bulb retaining ring by rotating counterclockwise (when viewed from rear) about one-eighth turn and sliding ring off plastic base. Keep ring as it may be used again to retain new bulb (Fig. 4).
5. Carefully remove headlamp bulb from socket in reflector by gently pulling straight backward out of socket. Do not rotate bulb during removal.

#### Installation

1. With flat side of plastic base of bulb facing upward, insert glass envelope of bulb into socket. Turn base slightly to left or right, if necessary, to align grooves in forward part of plastic base with corresponding locating tabs inside socket. When grooves are aligned, push bulb firmly into socket until mounting flange on base contacts rear face of socket.
2. Slip bulb retaining ring over rear of plastic base against mounting flange. Lock ring into socket by rotating ring clockwise. A stop will be felt when retaining ring is fully engaged.
3. Push electrical connector into rear of plastic base until it snaps and locks into position.
4. Turn headlamps on and check for proper operation.

**NOTE:** A properly aimed headlamp normally need not be reaimed after installation of this bulb. A burned out bulb should not be removed from the headlamp reflector until just before a replacement bulb is to be installed. Removal of a bulb for an extended period of time may allow contaminants (dust, moisture, smoke) to enter the headlamp body and affect the performance of the headlamp. When servicing the headlamp bulb, energize the bulb only while it is contained within the headlamp body.

### Headlamp Bulb E-150—E-350

#### Removal

1. Remove the headlamp retaining ring screws (Fig. 6), and remove the retaining ring. Do not disturb the adjusting screw settings.
2. Pull the headlamp bulb forward and disconnect the wiring assembly plug from the bulb.

#### Installation

1. Connect the wiring assembly plug to the new bulb. Place the bulb in position, making sure that the locating tabs of the bulb are fitted in the positioning slots.
2. Install the headlamp retaining ring (Fig. 6).
3. Adjust the headlamp aim using the Rotunda Headlamp Aiming Kit 107-00001 or equivalent, if required.

### Headlamp Switch

#### F-150—F-350 and Bronco

#### Removal

1. Disconnect the battery ground cable.
2. Remove the wiper-washer and headlamp switch knobs. Use a hook tool to release each knob lock tab.
3. Remove the fog lamp switch knob, if so equipped.
4. Remove the finish panel assembly (Fig. 7).
5. Unscrew the mounting nut. Remove the switch from instrument panel, then remove the wiring connector from the switch (Fig. 8).

#### Installation

1. To install the switch, connect the wiring connector to the headlamp switch, position the switch in the instrument panel and install mounting nut.
2. Install the trim finish panel assembly.
3. Install the headlamp switch knob. If so equipped, install the fog lamp switch.
4. Install the wiper-washer control knobs. Connect the battery cable, and check the operation of the headlamp switch.

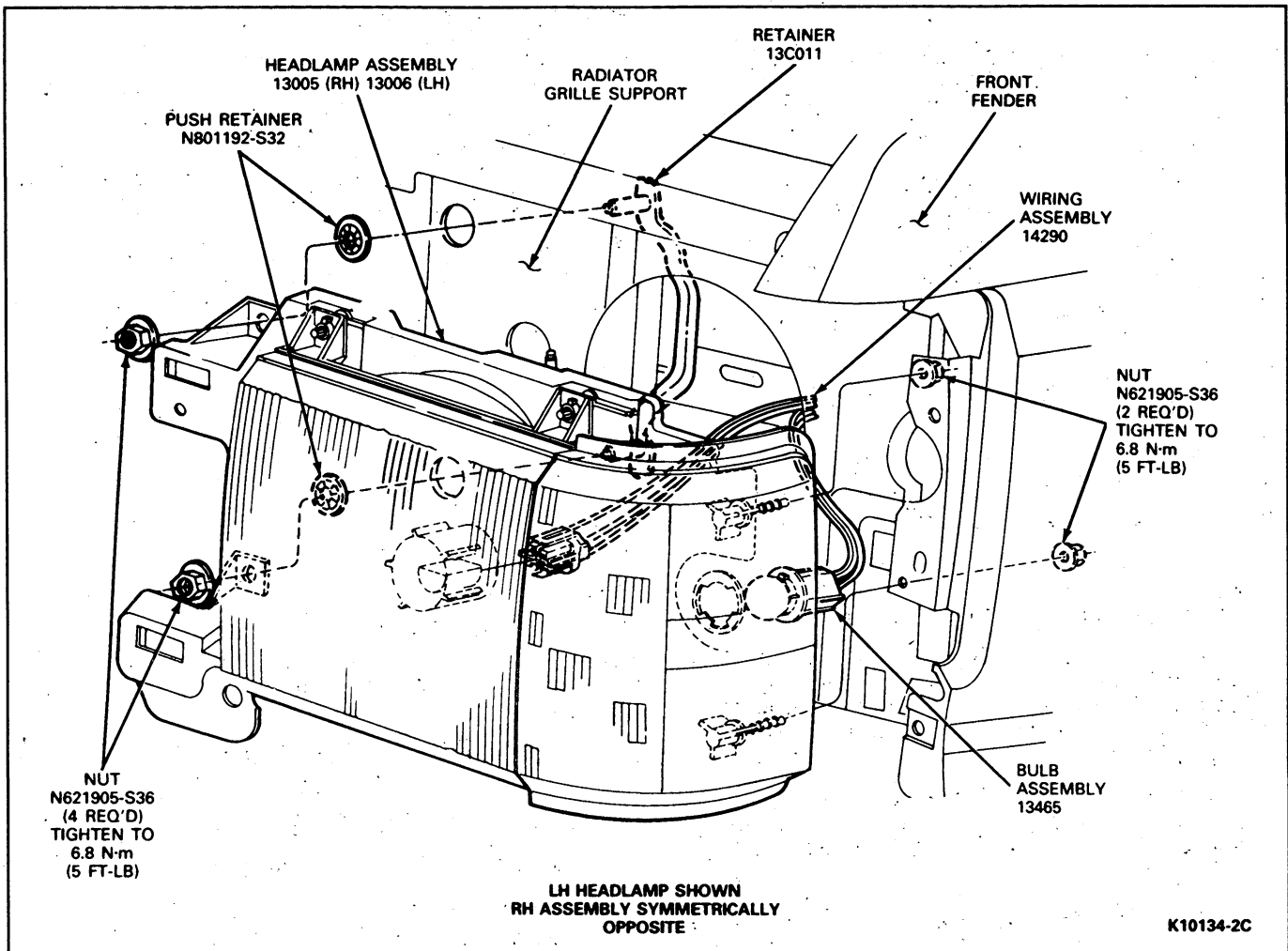
#### E-150—E-350

#### Removal

1. Disconnect the battery ground cable.
2. Remove the headlamp control knob and shaft by pressing the knob release button on the switch housing (Figs. 1 and 9), with the knob in the full ON position. Pull the knob and shaft assembly out of the switch. Unscrew the mounting nut or bezel nut. Remove the switch, then remove the wiring connector from the switch (Fig. 9).

#### Installation

1. To install the switch, connect the wiring connector to the headlamp switch, position the switch in the instrument panel, and install the bezel and mounting nut.



**FIG. 5 Headlamp—F-150—F-350 and Bronco**

2. Install the knob and shaft assembly by inserting it all the way into the switch until a distinct click is heard. In some instances it may be necessary to rotate the shaft slightly until it engages the switch-contact carrier.
3. Connect the battery ground cable.
4. Test lamps for proper operation.

### Dimmer Switch

#### Removal and Installation—F-150—F-350 and Bronco Shown—E-150—E-350 Similar

Pull the floor mat/carpet back in the area of the switch, and remove the mounting screws (Fig. 10). Disconnect the wire terminal block from the switch.

Install the switch to the floor, and connect the terminal block to the switch. Replace the floor mat. Check dimmer switch operation.

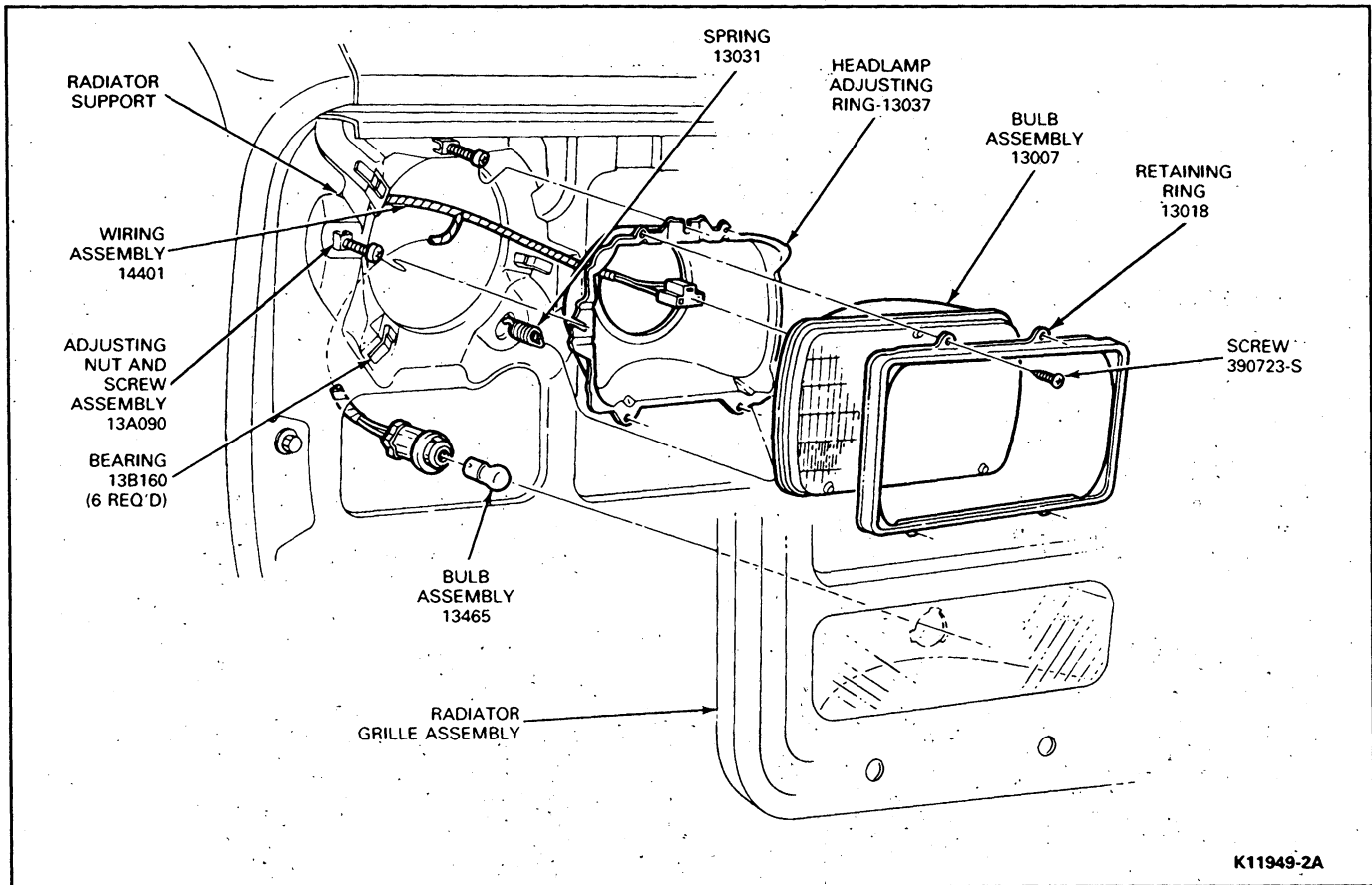


FIG. 6 Headlamp—E-150—E-350

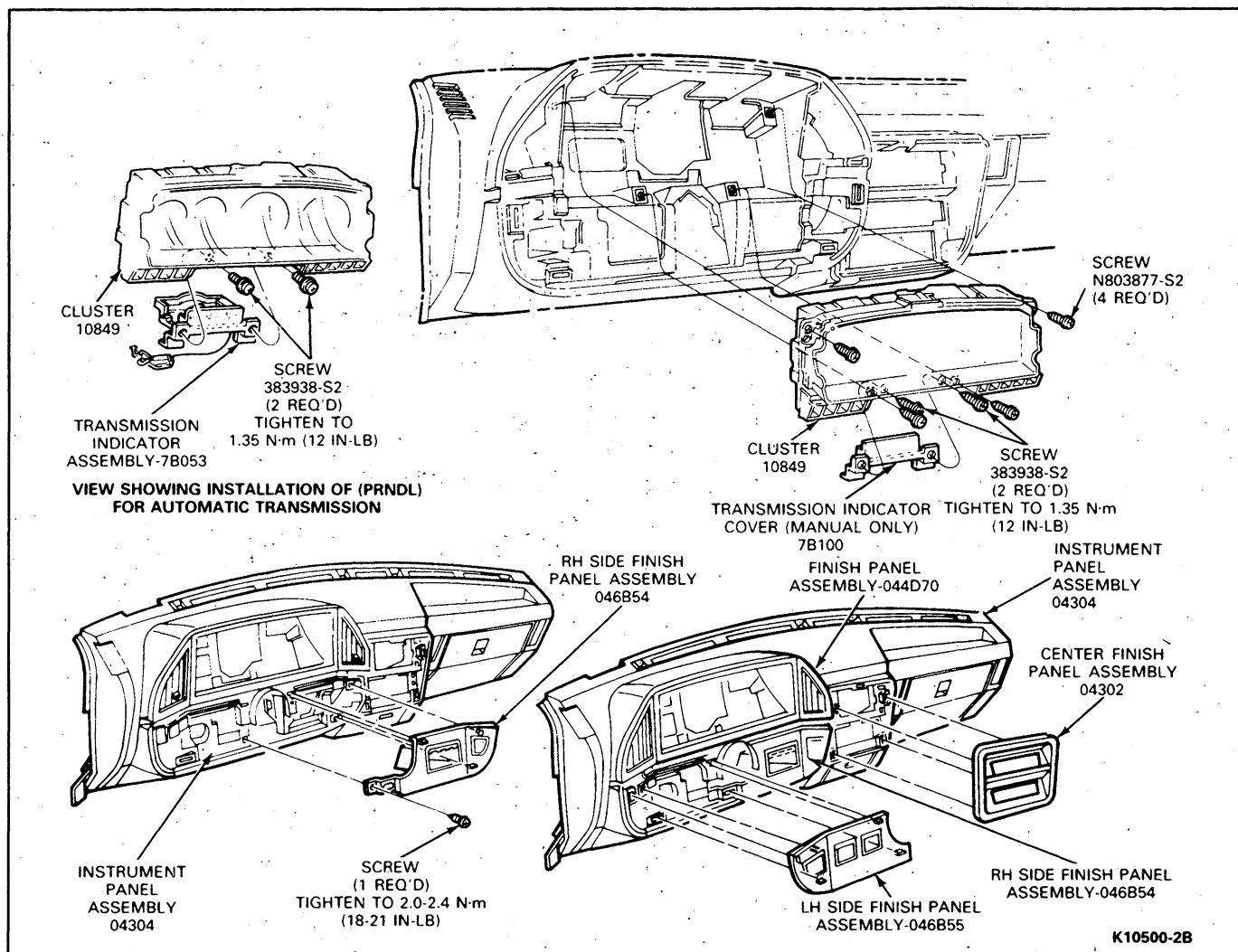


FIG. 7 Instrument Cluster—F-150—F-350 and Bronco

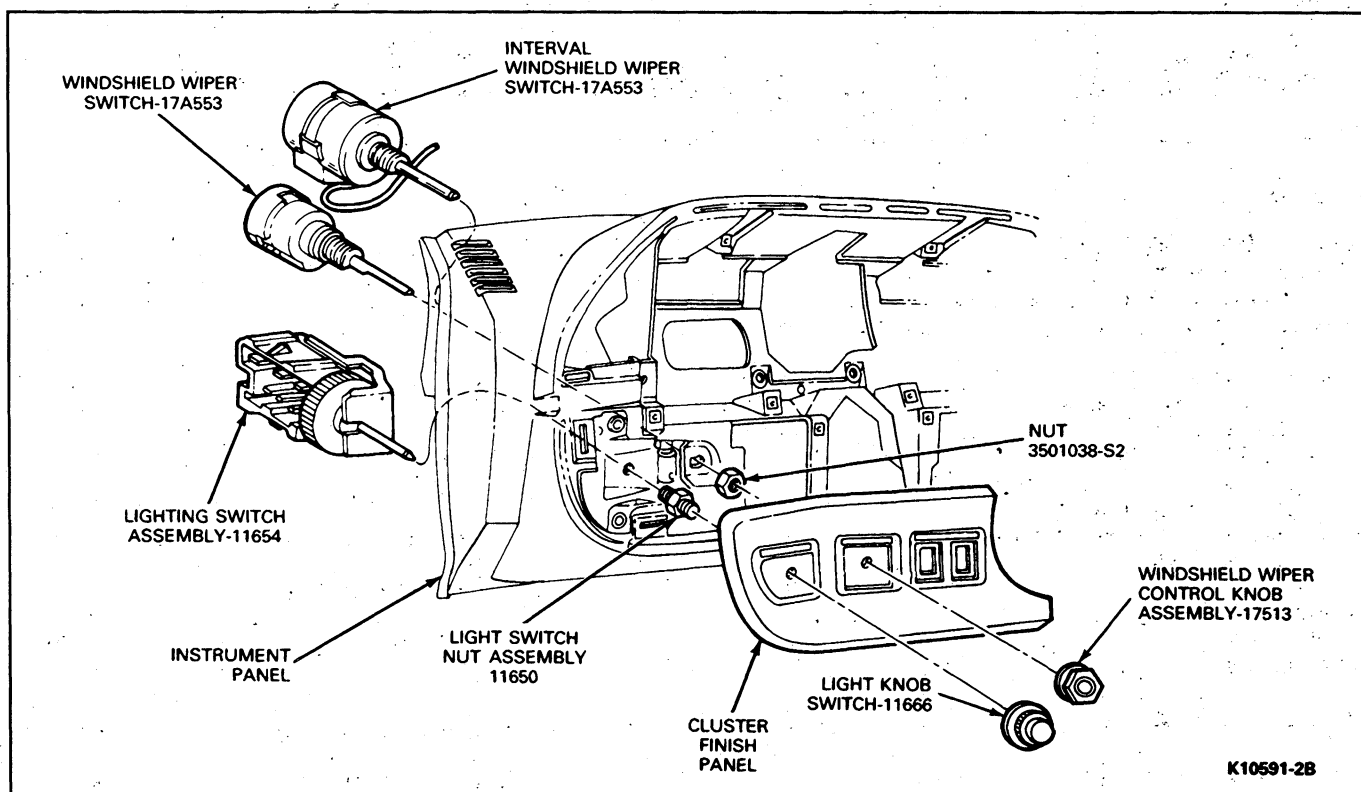


FIG. 8 Headlamp Switch Installation—F-150—F-350 and Bronco

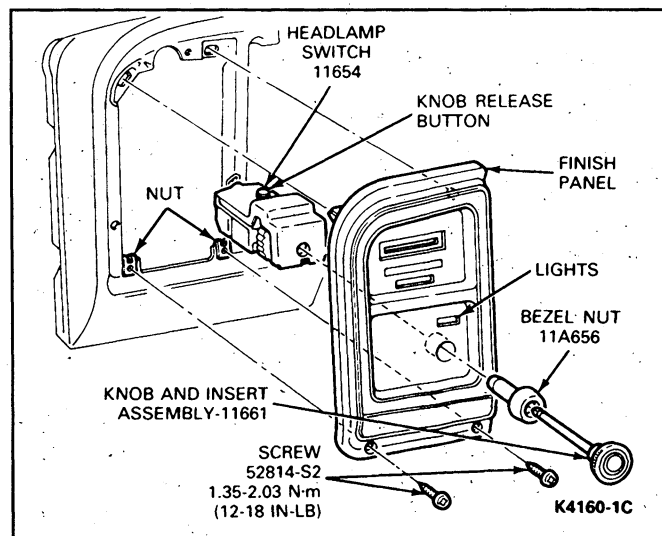


FIG. 9 Headlamp Switch Installation—E-150—E-350

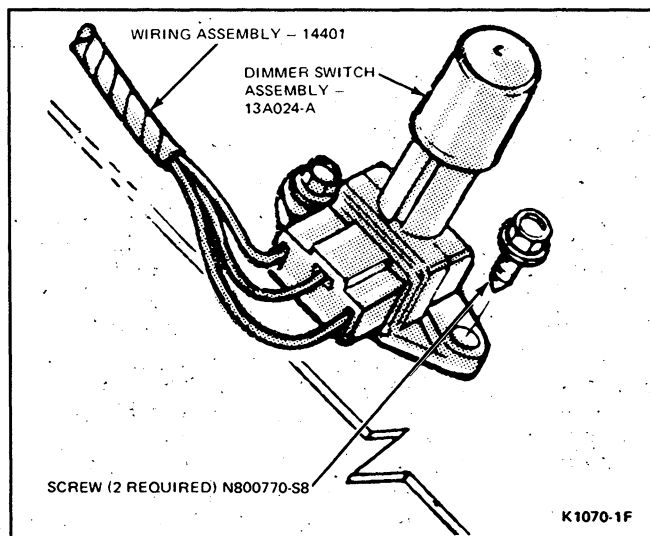


FIG. 10 Headlamp Dimmer Switch

## SPECIAL SERVICE TOOLS

### ROTUNDA EQUIPMENT

Model No.	Description
107-00001	Headlamp Aiming Kit

CK6756-1D

# SECTION 32-21 Parking, Rear and Marker Lamps

SUBJECT	PAGE	SUBJECT	PAGE
<b>DESCRIPTION AND OPERATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Stoplamp Switch .....	32-21-1	Parking Lamps .....	32-21-1
E-150—E-350, F-150—F-350, F-Super Duty		E-150—E-350 .....	32-21-1
and Bronco .....	32-21-1	F-150—F-350, F-Super Duty and	
<b>REMOVAL AND INSTALLATION</b>		Bronco .....	32-21-1
Backup Lamp Switch .....	32-21-4	Rear Lamps .....	32-21-1
Front Side Marker Lamps .....	32-21-1	F-150 — F-350 Flare Side Pickup .....	32-21-2
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All F-150—F-350, F-Super Duty (With		Rear Marker Lamps .....	32-21-2
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Bulb .....	32-21-2	E150—E350, F150-F350, F-Super Duty	
E-150—E-350 .....	32-21-3	and Bronco .....	32-21-4
Flare Side Only .....	32-21-3	<b>VEHICLE APPLICATION</b> .....	32-21-1
Lamp Assembly .....	32-21-2		

## VEHICLE APPLICATION

All E150-E350, F150-F350, F-Super Duty and Bronco Models.

## DESCRIPTION AND OPERATION

### Stoplamp Switch

#### E-150—E-350, F-150—F-350, F-Super Duty and Bronco

The mechanical stoplamp switch assembly, installed on the pin of the brake pedal arm, straddles the master cylinder push rod, but is not attached directly to the push rod (Fig. 1). The switch assembly moves with the pedal arm when the brake pedal is depressed.

The switch actuating pin is held by spring pressure against the rear end of the push rod. Because of the slight clearance between the eye of the master cylinder push rod and the brake pedal arm pin, the pin and the switch move forward slightly before the push rod moves when the pedal is depressed. This relative movement between the switch and the end of the push rod moves the actuating pin rearward in the switch, closing the switch contacts and completing the circuit to the stoplamps.

When the brake pedal is released, the switch moves rearward in relation to the push rod. The spring in the switch returns the actuating pin to its normal position, opening the switch contacts and interrupting the circuit to the stoplamps.

## REMOVAL AND INSTALLATION

### Front Side Marker Lamps

#### E-150—E-350

#### Removal and Installation

Remove two screws and lamp assembly. Disconnect socket from lamp body (Fig. 2). Replace bulb in socket,

if required. Install socket in lamp body and install lamp body to vehicle.

### Parking Lamps

#### F-150—F-350, F-Super Duty and Bronco

#### Removal and Installation

Remove headlamp assembly attaching nuts and retainers (Fig. 3). Pull assembly away from support and disconnect socket from lamp body. Replace bulb. Reverse procedure to install. Tighten attaching nuts to 6-8 N·m (4.5-6 ft-lb).

#### E-150—E-350

#### Removal and Installation

If lamp body replacement is required, remove headlamp trim ring and rim. Remove the lamp assembly by removing two mounting screws and/or nuts and disconnecting the socket from the lamp body. Reverse procedure to install.

### Rear Lamps

#### F-150—F-350 Style Side Pickup, Bronco and E-150—E-350

#### Removal and Installation

To replace a bulb in the combination taillamp, stoplamp, reflex and backup lamp, remove the screws that retain the lamp lens assembly to the vehicle and pull lamp lens away from vehicle (Figs. 4 and 5). Turn the socket with the burned out or broken bulb counterclockwise and replace the bulb. Install by turning clockwise into housing. Install lamp lens and retaining screws to vehicle.

NOTE: If lamp body or lens is damaged, replace entire lamp assembly. Lens and body are not serviced separately (Figs. 4 and 5).

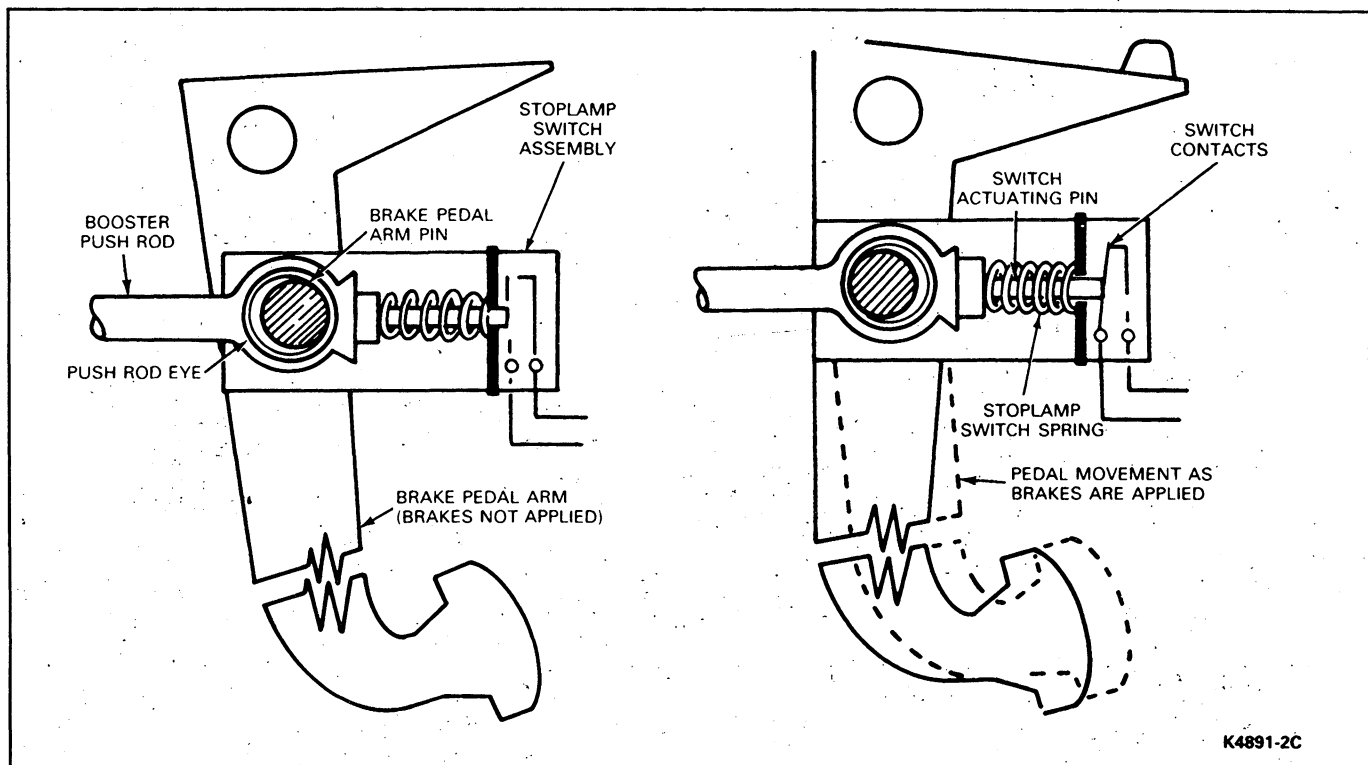


FIG. 1 Stoplamp Switch—F-150 Through F-350 F-Super Duty and Bronco, E-150—E-350

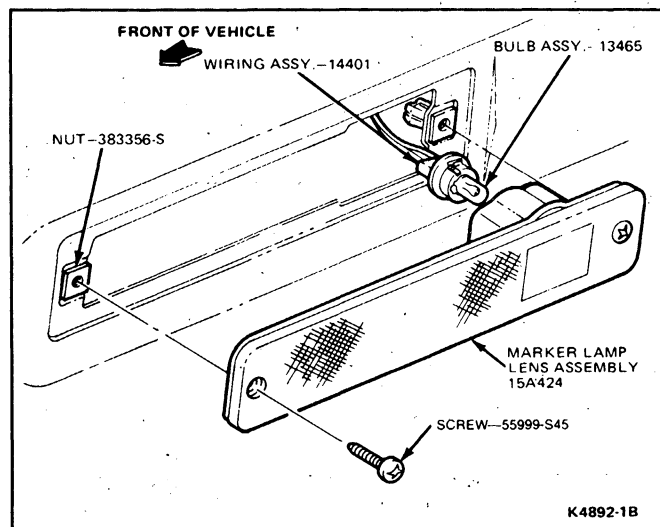


FIG. 2 Front and Rear Side Marker Lamp—E-150—E-350

### F-150 — F-350 Flare Side Pickup

#### Removal and Installation

The bulbs in the rear lamp body can be replaced by removing the lens retaining screws and pulling lens away from vehicle.

To replace the lamp assembly, remove the three nuts from the mounting studs. Disconnect the two connectors (red-black stripe wire and wire with green insulator) inside the frame side rail (Fig. 6). Unhook the wires from the retaining clip and pull the wires out. Insert the studs of the replacement lamp body into the holes of the lamp mounting bracket. Tighten the stud nuts.

### Rear Marker Lamps

#### E-150—E-350

#### Removal and Installation

Replacement of the bulb, the lamp assembly, or the socket and wiring assembly requires removal of the lamp assembly from the side of the vehicle as shown in Fig. 2. Disengage the bulb socket from the rear of the lamp assembly by turning counterclockwise. With the socket disengaged the lamp bulb can be replaced. If the socket and wiring assembly is to be replaced, disconnect the wiring at the connector and ground screw.

### License Plate Lamp

#### All F-150—F-350, F-Super Duty (With Rear Bumper) and Bronco

#### Bulb

#### Removal and Installation

To replace the rear license lamp bulb, rotate socket one-quarter turn from backside of lamp (Fig. 7) and remove the bulb. To install, reverse removal procedure.

#### Lamp Assembly

#### Removal and Installation

To remove the lamp assembly, push lamp assembly out from behind or pry out from outside (Fig. 7). To install, reverse removal procedure.

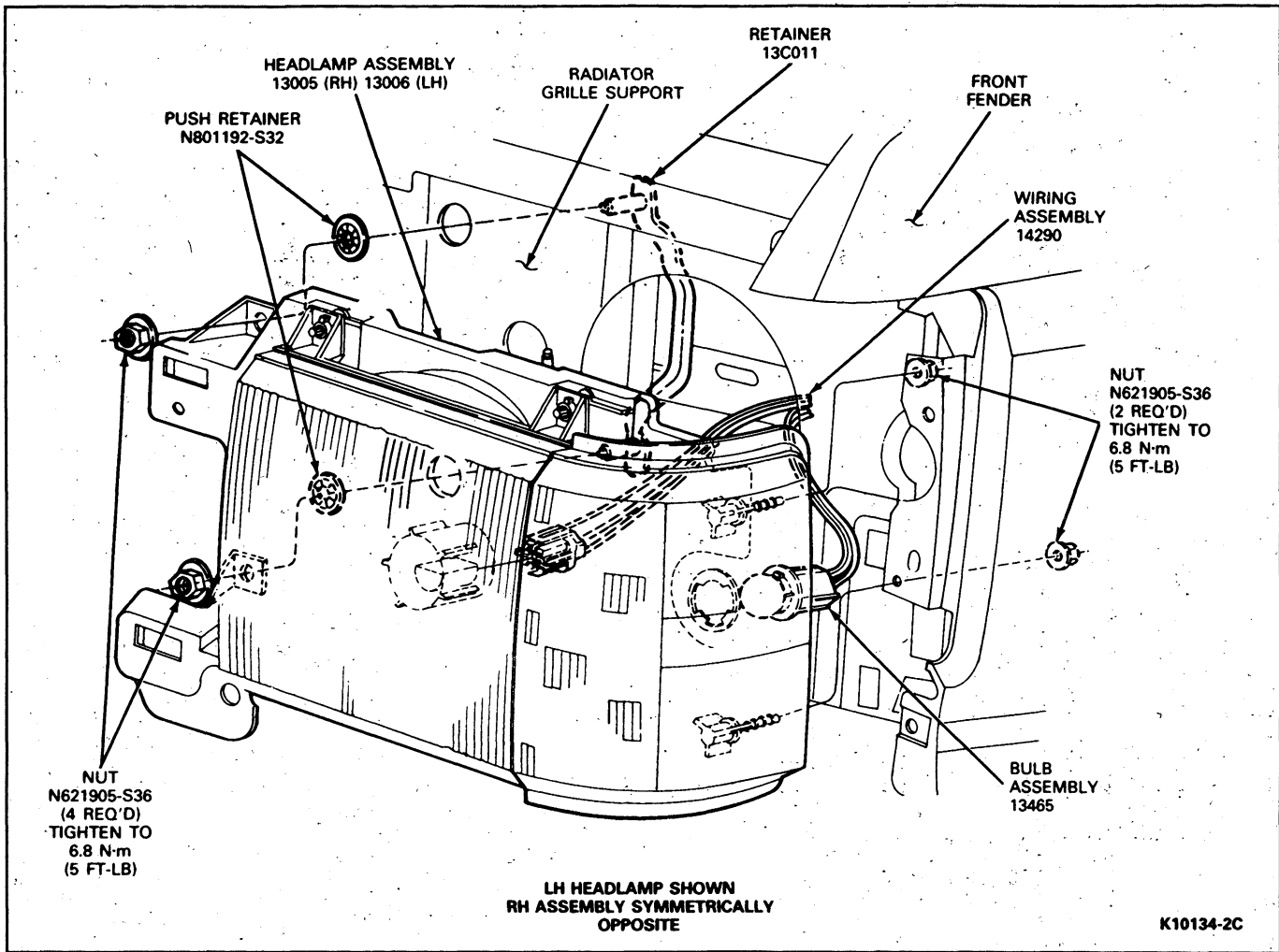


FIG. 3 Parking Lamp—F-150—F-350, F-Super Duty and Bronco

**All F-150—F-350, F-Super Duty (Without Rear Bumper)**

**Bulb**

**Style Side Only**

**Removal and Installation**

1. Remove screw retaining rear license lamp cover to assembly.
2. Remove the bulb and replace with a new bulb.
3. Install cover and screw to rear license lamp assembly (Fig. 7).

**Lamp Assembly**

**Removal and Installation**

1. Remove two screws that retain the assembly to license bracket.
2. Disconnect wiring connector.
3. To install, connect wiring connector to lamp assembly. Position lamp assembly to license bracket and install the two retaining screws (Fig. 7).

**Flare Side Only**

**Removal and Installation**

**Refer to Fig. 6**

1. Remove two screws that retain the lamp assembly.
2. Remove lamp socket from lamp assembly by rotating socket counterclockwise one-eighth-turn and pull socket from lamp body. Remove bulb by pulling outwards.
3. To install, push bulb into socket.
4. Install lamp and retaining screw.

**E-150—E-350**

**Removal and Installation**

To replace the bulb of the E-150—E-350 license plate lamp assembly (Fig. 8) remove the lamp socket from the lamp assembly from inside the LH rear door by twisting counterclockwise. Remove the bulb, install a new bulb and twist the socket into the lamp assembly.

To replace the lamp assembly, remove the three screws accessible from rear door inside opening that retain the assembly to the door. Pull the lamp sockets out of the lamp assembly and remove the assembly from the door. To install, reverse this procedure.



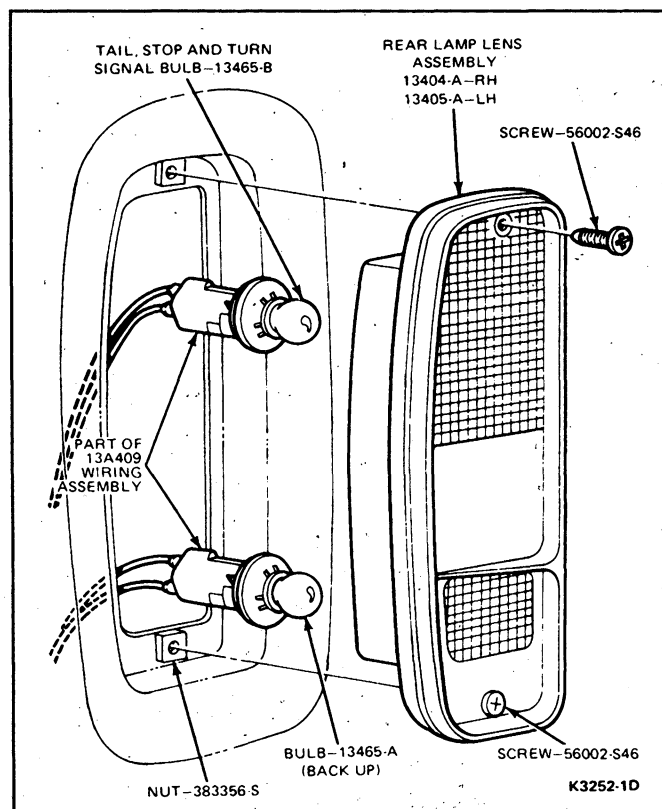


FIG. 4 Rear Lamp—E-150—E-350

### Stoplamp Switch

**E150—E350, F150-F350, F-Super Duty and Bronco**

#### Removal and Installation

1. Disconnect wire harness connector from switch.  
NOTE: Locking tab must be lifted before connector can be removed.

2. Remove the hairpin retainer. Slide stoplamp switch, push rod, nylon washer and bushing away from the pedal. Remove washer and then the switch by sliding switch up or down (Fig. 9).

NOTE: Since the switch side plate nearest the brake pedal is slotted, it is not necessary to remove the brake master cylinder push rod and bushing from the brake pedal pin. On vehicles equipped with speed control, the spacer washer is replaced by the dump valve adapter washer assembly.

3. Position switch so that the U-shaped side is nearest the pedal and directly over/under the pin. Then, slide switch up/down trapping the master cylinder push rod and bushing between the switch side plates.

Push switch and push rod assembly firmly toward brake pedal arm. Assemble outside white plastic washer to pin. Install hairpin retainer to hold entire assembly.

**CAUTION: Do not substitute other types of pin retainers. Use only factory-supplied hairpin retainer.**

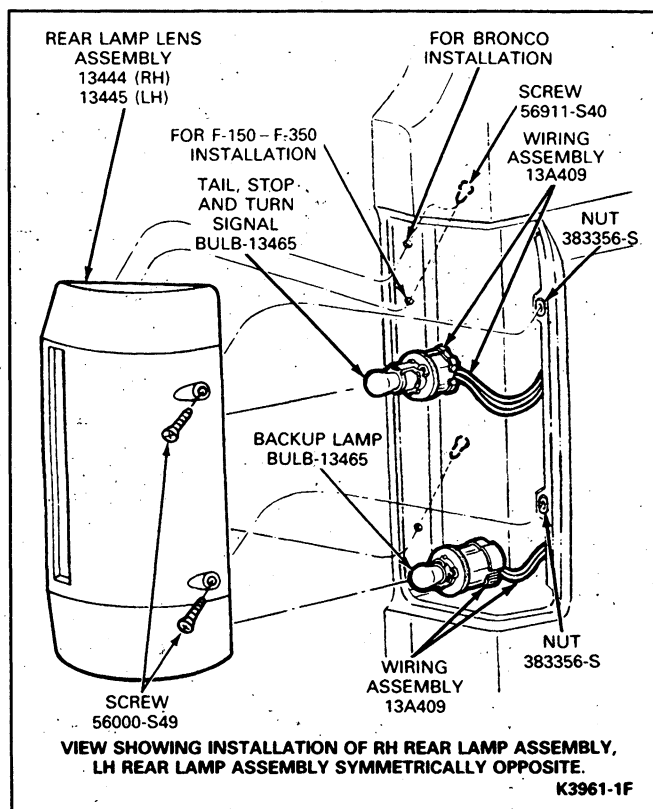


FIG. 5 Rear Lamps—Bronco and F-150—F-350 Styleside and F-Super Duty

4. Install connector to the switch (Fig. 9).
5. Check stoplamp switch for proper operation.

**CAUTION: Stoplamp switch wire harness must have sufficient length to travel with switch during full stroke of pedal. If wire length is too short, reroute or repair harness as required.**

### Backup Lamp Switch

**All F-150—F-350, F-Super Duty and E-150—E-350 with 5 Speed Manual Overdrive Transmission**

The backup lamp switch is mounted on the driver's side of the transmission assembly (Fig. 10 and 11). The switch (C9TZ-15520-C) is not adjustable. To remove the switch, place the transmission selector lever in any position other than REVERSE and disconnect the electrical connector from the switch. Remove the switch from the transmission assembly. Install new switch in reverse order.

### Roof Marker Lamps

#### Removal and Installation

To remove roof marker lamps (Fig. 12), remove two screws securing marker to roof and lift lamp enough to see electrical connector. Tape wiring assembly 15A404 to roof of vehicle and disconnect electrical connector. Remove marker lamp from vehicle.

To install roof marker lamps, position pad over electrical wires and connect electrical connector. Remove tape from wiring assembly. Position marker lamp to roof. Secure with two screws. Tighten screws to 0.90-2.25 N·m (8-20 in-lb).

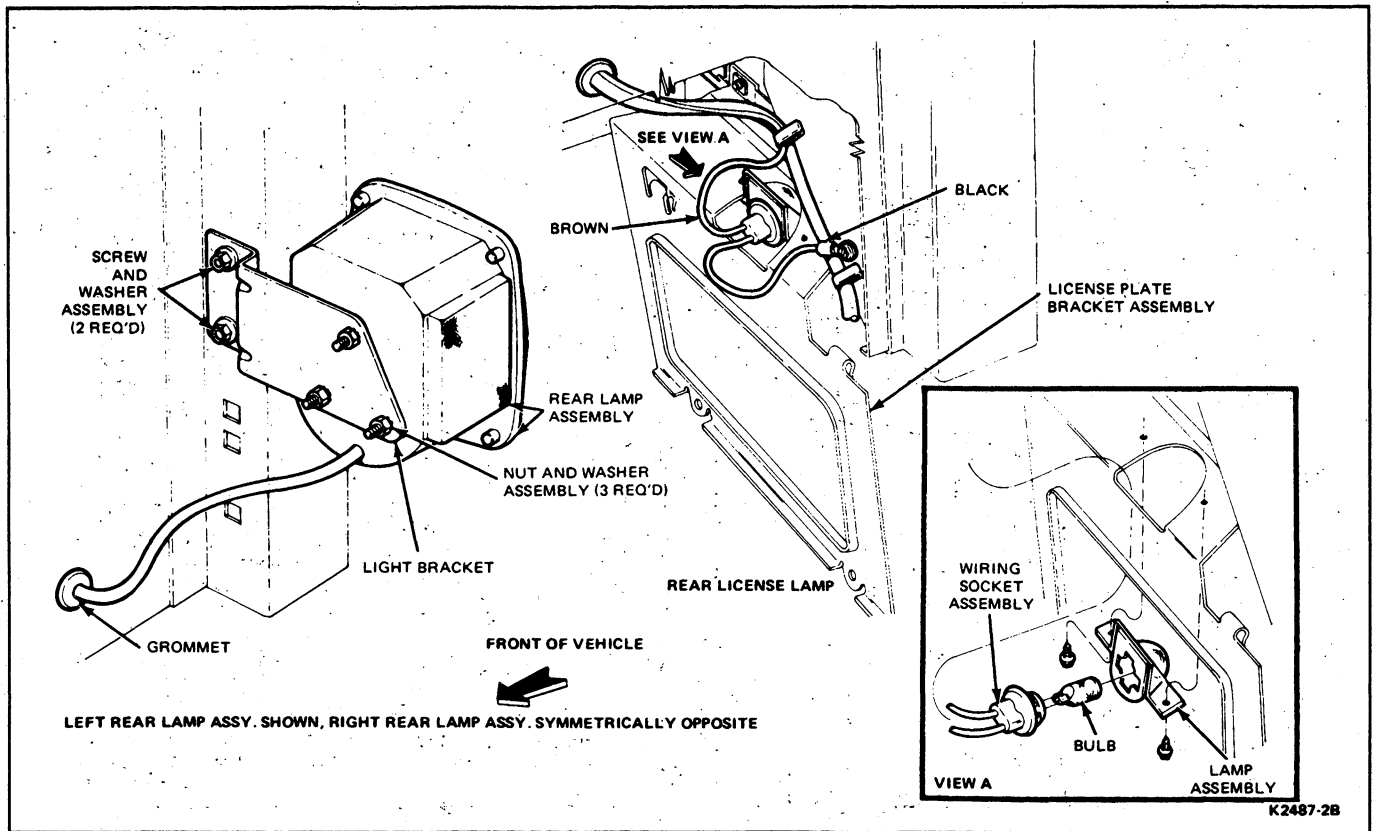
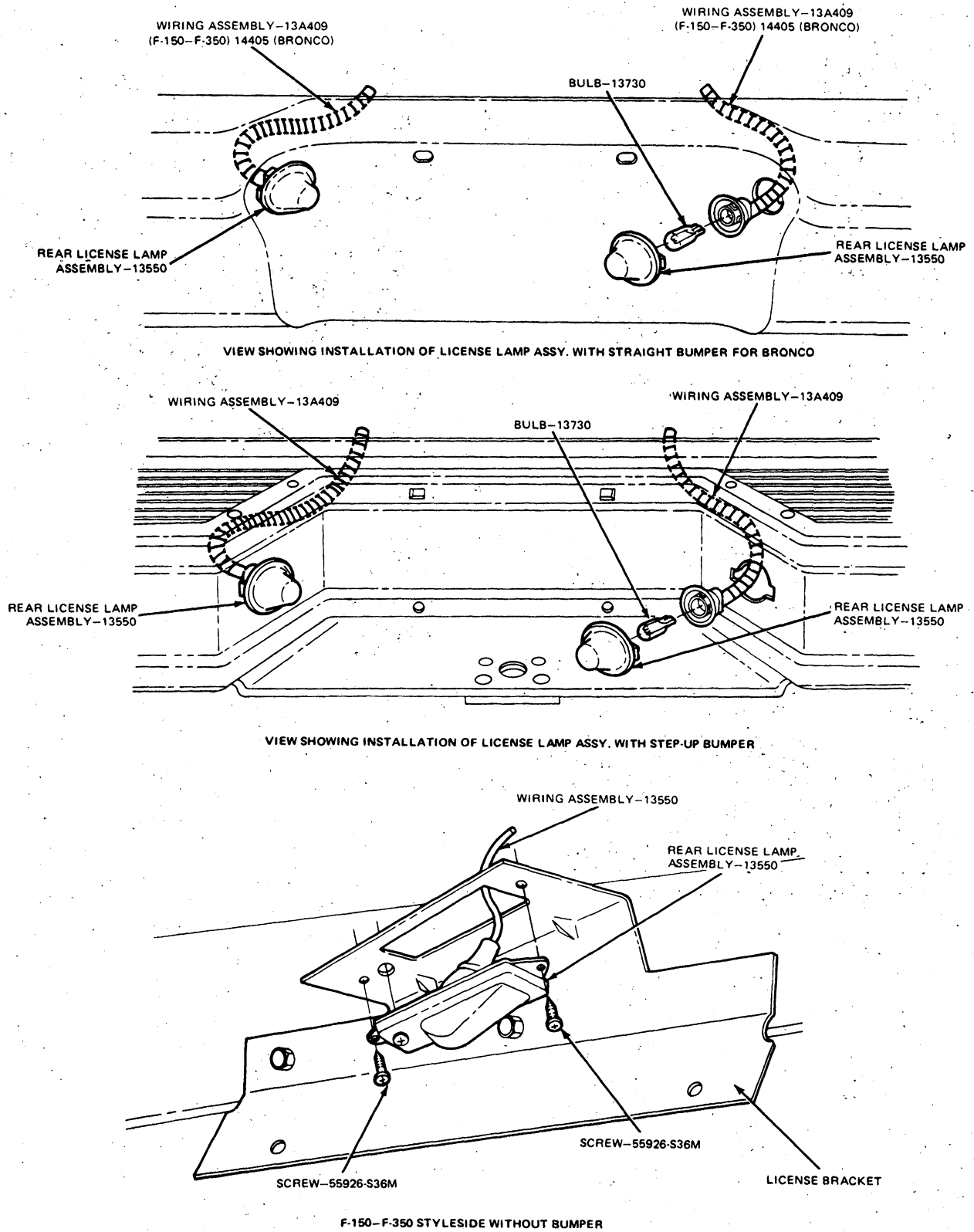


FIG. 6 Rear Side Marker and License Plate Lamps—F-150, and F-250, Flare Side Pick-Up



K3962-2B

FIG. 7 License Plate Lamp—F-150—F-350 Styleside and Bronco

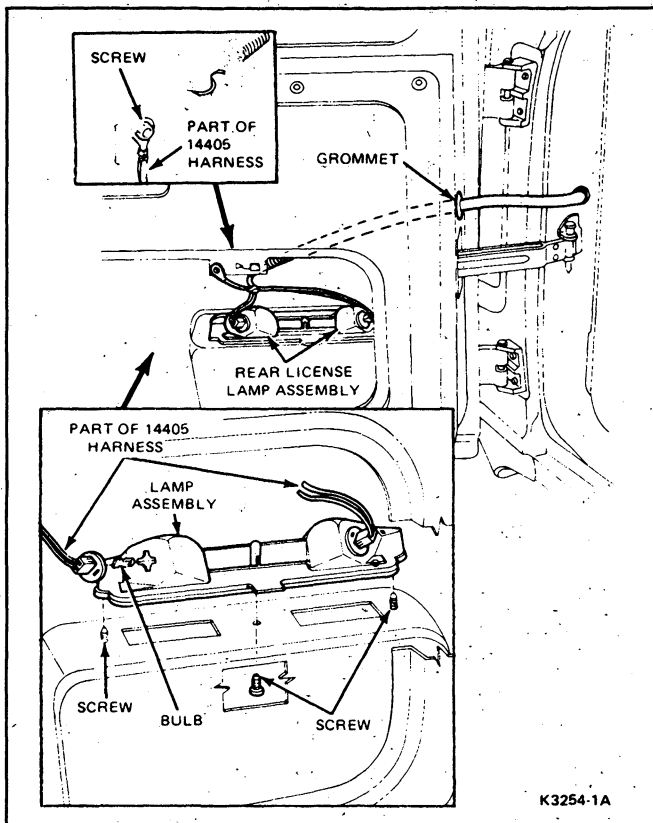


FIG. 8 License Plate Lamp—E-150—E-350

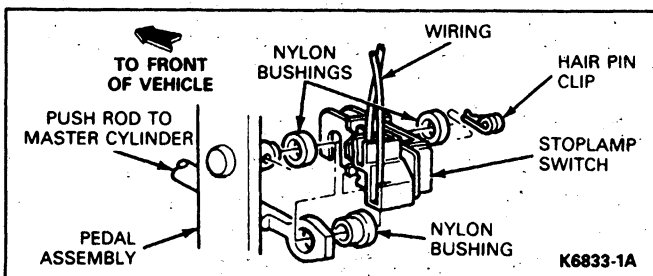


FIG. 9 Stoplamp Switch—Installed—With Power Brakes

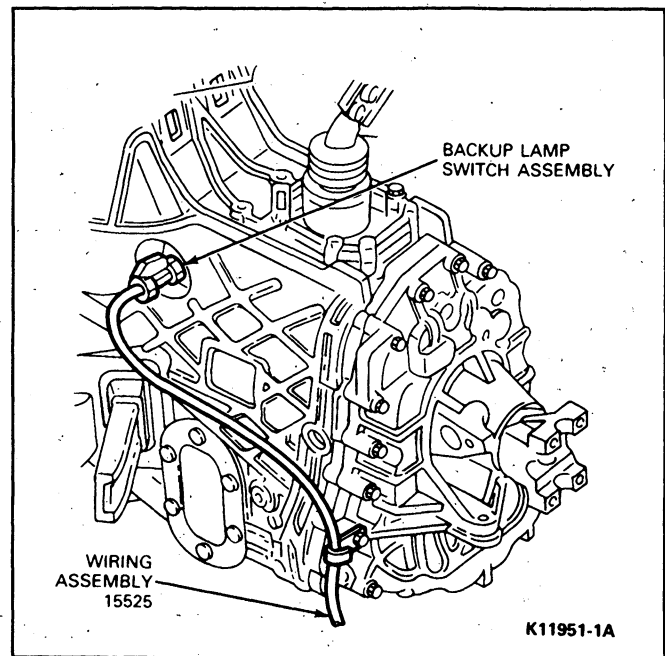


FIG. 10 Backup Lamp Switch—Typical

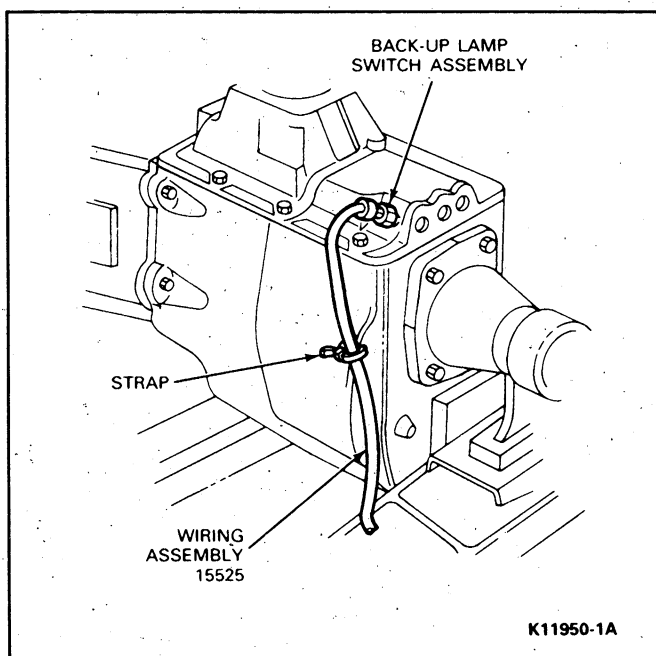


FIG. 11 Backup Lamp Switch-Installed—E-150—E-350

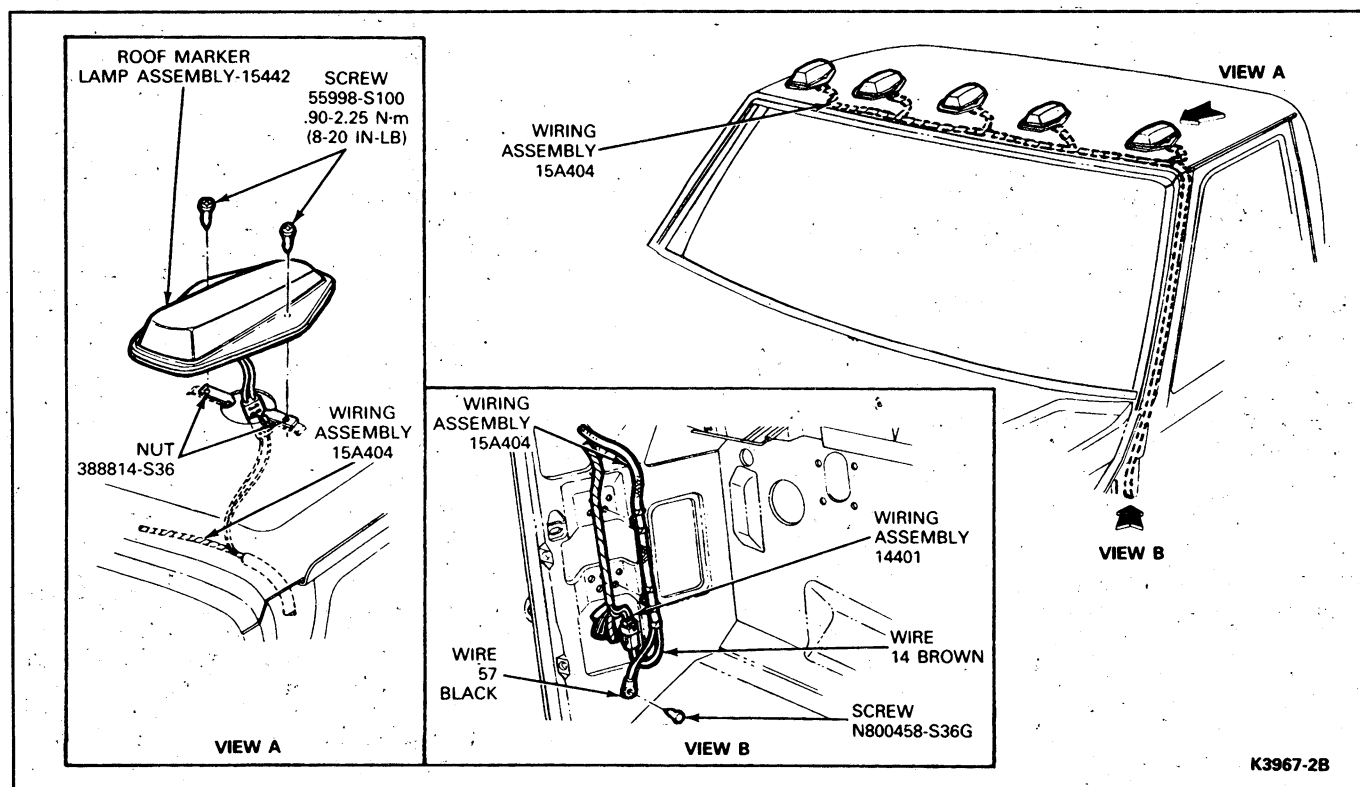


FIG. 12 Roof Marker Lamps—F-150—F-350 and F-Super Duty

# SECTION 32-41 Turn Signal and Hazard Warning Flashers

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION .....	32-41-1	DIAGNOSIS AND TESTING (Cont'd)	
DIAGNOSIS AND TESTING		Turn Signal Switch Test By	
Bulb Socket Ground Test .....	32-41-4	Substitution .....	32-41-3
Bulb Sockets Power Test .....	32-41-3	DIAGNOSIS GUIDES .....	32-41-5
Hazard Warning Flasher Power Test .....	32-41-4	REMOVAL AND INSTALLATION	
Hazard Warning Flasher Switch Test In		Flasher Units .....	32-41-12
Turn Signal Switch Assembly Power		Turn Signal/Hazard Warning Flasher	
Test .....	32-41-4	Switch .....	32-41-10
Turn Signal Flasher Power Test .....	32-41-1	SPECIAL SERVICE TOOLS .....	32-41-12
Turn Signal Switch Power-In Test .....	32-41-1	VEHICLE APPLICATION .....	32-41-1
Turn Signal Switch Power-Out Test .....	32-41-2		

## VEHICLE APPLICATION

All E-150-E-350, F-150-F-350, F-Super Duty and Bronco Models.

## DESCRIPTION AND OPERATION

The turn signal/hazard warning flasher switch is located in the upper steering column hub. The turn signal switch is operated by a lever on the LH side of the hub. The hazard warning flasher switch is located on the RH side of the hub. Two flasher units are used, one for the turn signal circuit and the other for the hazard warning flasher circuit.

On E-150—E-350, the turn signal flasher is attached to the lower reinforcement of the instrument panel on the LH side of the steering column (Fig. 1). The hazard warning flasher is taped to the main wiring assembly in the lower LH corner of the instrument panel (Fig. 1) on E-150—E-350. On F-150—F-350, F-Super Duty and Bronco, the turn signal flasher is mounted on the front of the fuse panel (Fig. 2), and the hazard warning flasher is mounted on the RH side panel of the instrument panel (Fig. 3).

To operate the turn signals, the ignition switch must be in the RUN position on the F-150—F-350, F-Super Duty and Bronco. The ignition switch must be in either

the ACC or RUN position to operate the turn signals on E-150—E-350. The hazard warning system is operated independently of the ignition switch by actuating the hazard warning switch.

## DIAGNOSIS AND TESTING

Common point diagnosis should be used to isolate or pinpoint the most probable cause of a problem in a multi-load circuit (a circuit with more than one operating component) without making any tests. If one system functions properly but another does not, the problem must be in the part of the circuit unique to the inoperative system. (See Fig. 4).

If more than one circuit does not operate, check for blown fuses. Refer to Section 34-31, Fuses, Circuit Breakers and Fuse Links.

### Turn Signal Flasher Power Test

1. Turn ignition switch to RUN position.
2. Connect 12-volt test lamp to a good ground (Fig. 5).
3. For E-150—E-350, contact probe of test lamp to the orange/yellow wire connection at the flasher (Fig. 5). For F-150—F-350—F-Super Duty, remove flasher from fuse panel and contact probe of test lamp to upper horizontal terminal in fuse panel. If test lamp illuminates, power flow to flasher is good. If test lamp does not illuminate, power is disrupted between flasher and power source. Feed circuit must be repaired.

### Turn Signal Switch Power-In Test

1. Turn ignition switch to RUN position.
2. Connect 12-volt test lamp to a good ground (Fig. 6).
3. Contact probe of test lamp to the wire connection at the switch (light blue wire, circuit No. 44) (Fig. 6). If test lamp illuminates, power flow to switch is good. Test lamp should illuminate intermittently due to action of flasher. If test lamp does not illuminate after ten seconds of continuous contact, power flow is disrupted between turn signal flasher

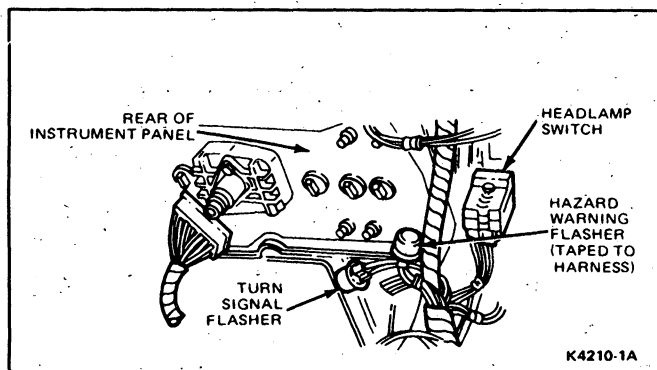


FIG. 1 E-150—E-350 Turn Signal and Hazard Warning Flashers

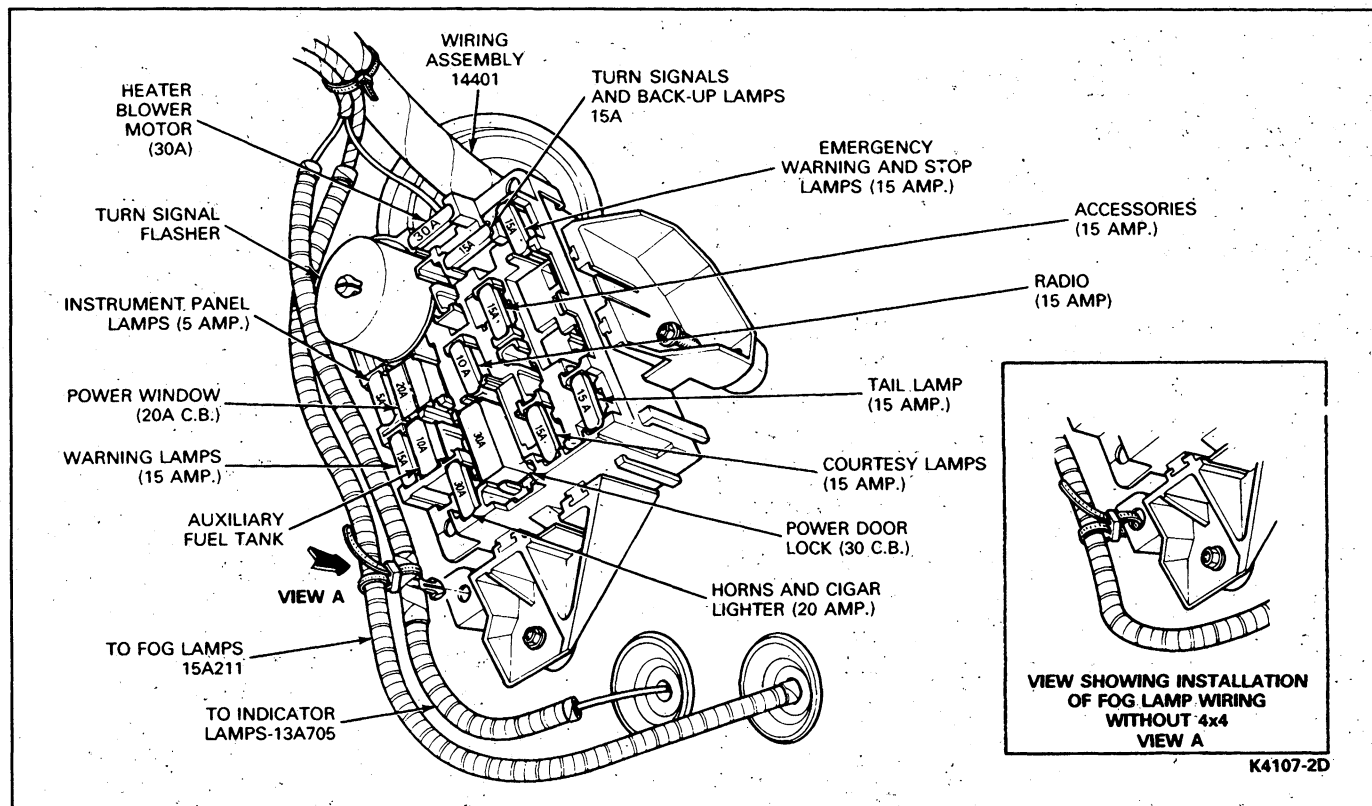


FIG. 2 F-150—F-350, F-Super Cab and Bronco Turn Signal

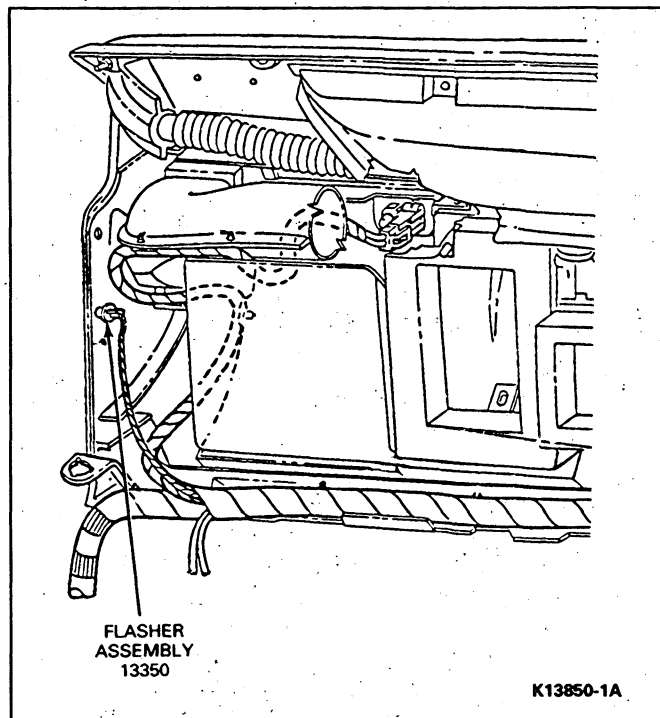


FIG. 3 F-150—F-350 and Bronco Hazard Warning Flasher

and switch. Feed circuit No. 44 (light blue wire) must be repaired, or flasher must be replaced.

### Turn Signal Switch Power-Out Test

1. Turn ignition switch to RUN or ACC position.

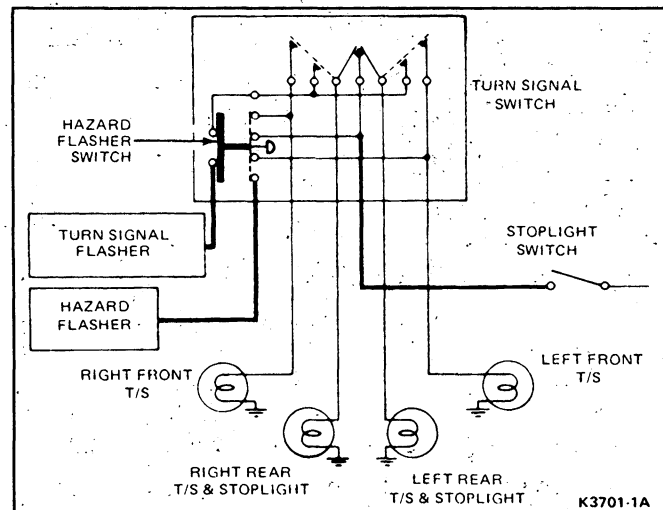


FIG. 4 Circuit Common Points

2. Position turn signal switch lever to ON position for LH and RH turns as required.
3. Connect 12-volt test lamp to a good ground (Fig. 7).
4. Contact probe of test lamp to the wire connection at the switch (Fig. 7) to check for continuity to the following turn signal lights:

Left-Front (green wire with white stripe—Circuit No. 3).

Left-Rear F-150—F-350—F-Super Duty (light green wire with orange stripe—Circuit No. 9; E-150—E-350—yellow wire with black stripe—Circuit No. 283).

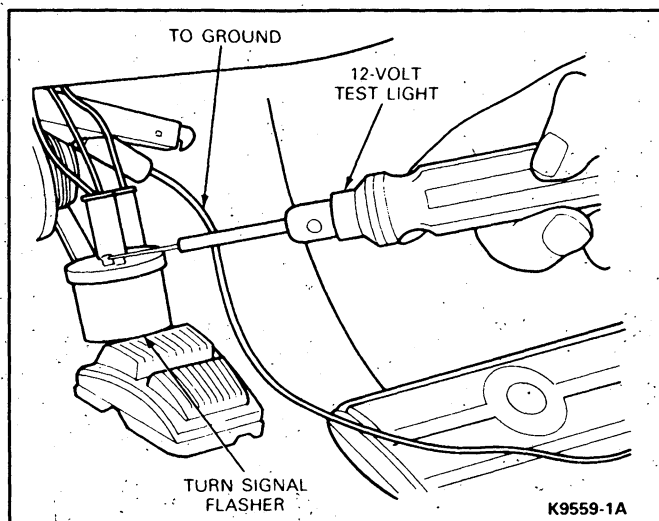


FIG. 5 Turn Signal Flasher Power Test—E-150—E-350

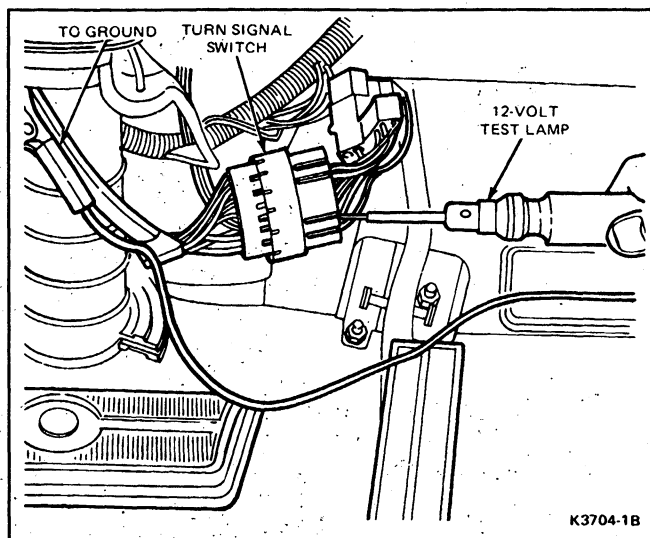


FIG. 7 Turn Signal Switch Power Out Test

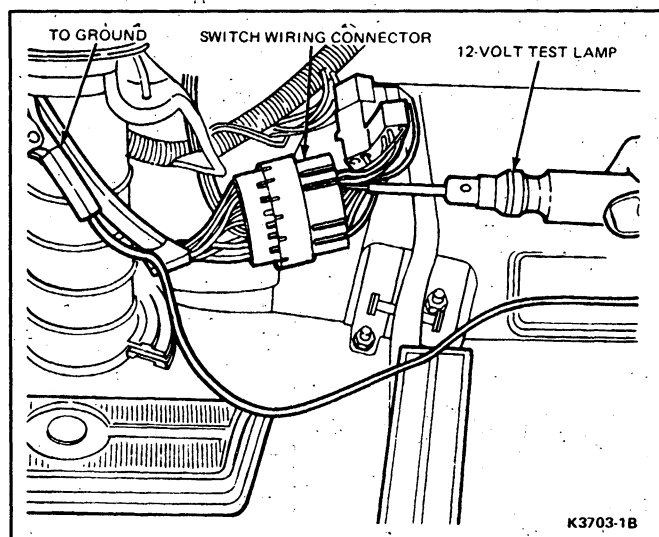


FIG. 6 Turn Signal Switch Power In Test

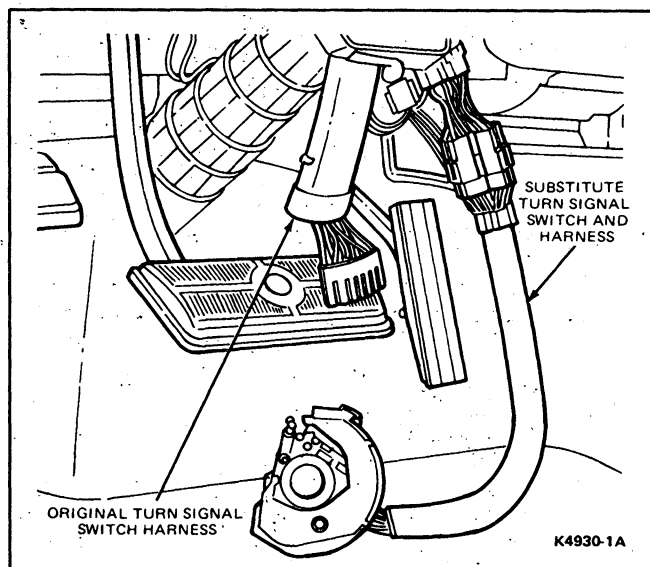


FIG. 8 Signal Switch Test By Substitution

Right-Front (white wire with blue stripe—Circuit No. 2).

Right-Rear F-150—F-350—F-Super Duty (orange wire with light blue stripe—Circuit No. 5; E-150—E-350—green wire—Circuit No. 282).

Test lamp should illuminate intermittently, due to action of flasher.

If the continuity through switch is not okay, repair or replace the switch as required.

It is important to note that the turn signal switch can also be tested by substitution.

### Turn Signal Switch Test By Substitution

The turn signal switch can also be checked by plugging a new unit into the main wiring harness (Fig. 8).

Operate the controls to determine if the circuits (including the hazard flasher) function. If not, repair or replace the turn signal switch as necessary.

### Bulb Sockets Power Test

1. Turn ignition switch to RUN position.

2. Position turn signal switch lever to ON position for LH or RH turn as required.
3. Connect 12-volt test lamp to a good ground (Fig. 9).
4. Contact probe of test lamp to the wire connection at the bulb socket (Fig. 9) to check for continuity to the following turn signal lamps:

Left-Front (green wire with white stripe—Circuit No. 3).

Left-Rear F-150—F-350, F-Super Duty (light green wire with orange stripe—Circuit No. 9; E-150—E-350—yellow wire with black stripe—Circuit No. 283).

Right-Front (white wire with blue stripe—Circuit No. 2).

Right-Rear F-150—F-350, F-Super Duty (orange wire with light blue stripe—Circuit No. 5; E-150—E-350—green wire—Circuit No. 282).

If the continuity to bulb socket is not okay, repair circuit(s) between turn signal switch and lamp sockets.



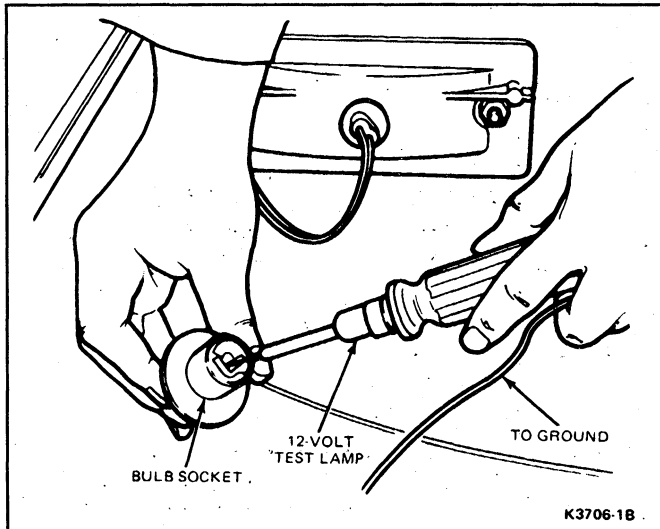


FIG. 9 Bulb Sockets Power Test

### Bulb Socket Ground Test

1. Turn ignition switch to RUN position.
2. Position turn signal switch lever to ON position for LH or RH turn as required.
3. Connect 12-volt test lamp to ground strap on lamp socket (Fig. 10).
4. Contact probe of test lamp to the wire connection at the lamp socket to check for continuity to ground.

If test lamp illuminates, ground is good.

If test lamp does not illuminate, ground circuit is incomplete and must be repaired.

### Hazard Warning Flasher Power Test

1. Connect a 12-volt test lamp to a good ground.
2. Contact probe of test lamp to the wire connection at hazard flasher socket (red wire with white—Circuit No. 383). Refer to Figure 11. Hazard warning flasher is taped to windshield wiper/washer wiring behind wiper/washer switch on

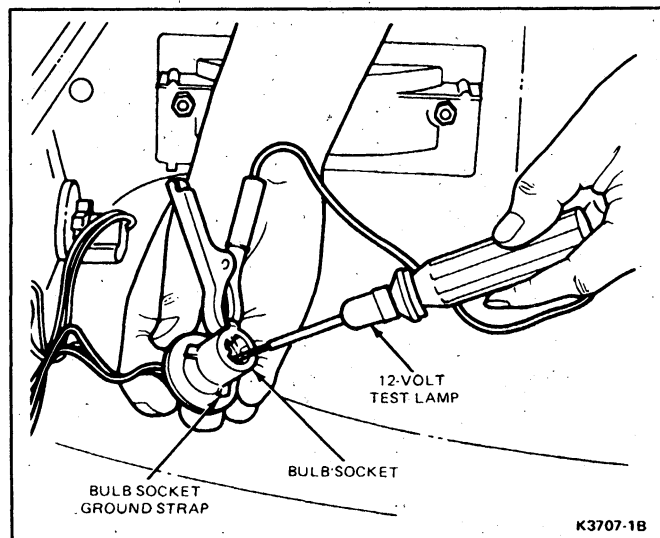


FIG. 10 Bulb Socket Ground Test

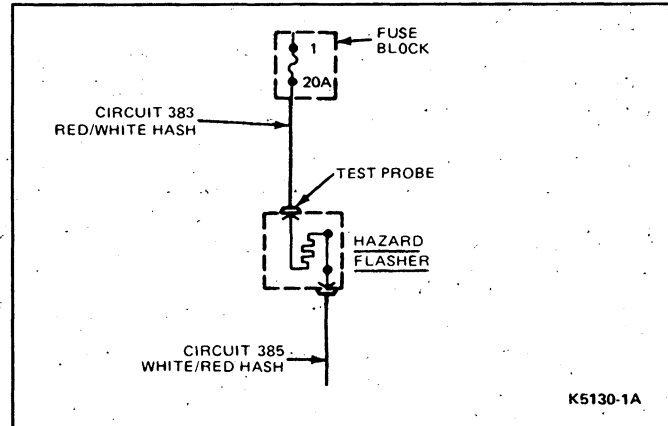


FIG. 11 Hazard Warning Flasher Power Test

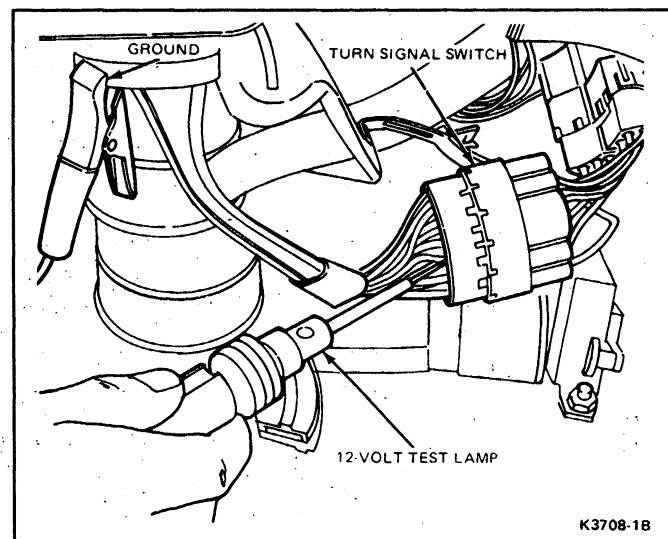


FIG. 12 Hazard Warning Flasher Switch In Turn Signal Switch Assembly Power Test

E-150—E-350. On F-150—F-350, F-Super Duty and Bronco the hazard warning flasher is mounted on the RH end panel of the instrument panel (Figs. 1 and 3).

If test lamp illuminates, power flow to hazard warning flasher is good.

If test lamp does not illuminate, power flow is disrupted between fuse and flasher. Feed circuit (red wire with white stripe—Circuit No. 383) must be repaired.

### Hazard Warning Flasher Switch Test In Turn Signal Switch Assembly Power Test

1. Connect a 12-volt test lamp to a good ground (Fig. 12).
2. Contact probe of test lamp to the wire connection at the turn signal switch (white wire with red stripe—Circuit No. 385) as shown in Fig. 12.

If test lamp illuminates, power flow to switch is good.

If test lamp does not illuminate, power flow is disrupted between the flasher and the switch. Feed circuit (white wire with red stripe—Circuit No. 385), or flasher must be repaired.

## DIAGNOSIS GUIDES

The following Diagnosis Guides can be used with the test procedures described above as an aid when diagnosing the turn signal and hazard warning systems.

### TURN SIGNAL LAMPS LIGHT BUT DO NOT FLASH ON BOTH SIDES

TEST STEP		RESULT	ACTION TO TAKE
1.0	VERIFY CONDITION		GO to 1.1.
1.1	DISCONNECT FLASHER		
	<ul style="list-style-type: none"> <li>Disconnect turn signal flasher.</li> <li>Turn on signals.</li> </ul>	Lamps go out on the side being operated Lamps remain on	REPLACE flasher with known good unit. REPEAT test. CORRECT short in wiring and INSTALL original flasher. REPEAT test.





CK6154-2A

### TURN SIGNAL LAMPS — ALL LAMPS INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
2.0	VERIFY CONDITION		
	<ul style="list-style-type: none"> <li>Verify the condition making sure hazard warning switch is in the OFF position.</li> </ul>		GO to 2.1.
2.1	CHECK FUSE		
	<ul style="list-style-type: none"> <li>Check operation of a circuit that shares the same fuse — or check fuse.</li> </ul>	<del>OK</del> OK	REPLACE fuse. If fuse blows again, CHECK for short circuit(s). GO to 2.2.
2.2	CHECK TURN SIGNAL FLASHER		
	<ul style="list-style-type: none"> <li>Substitute a known good turn signal flasher.</li> </ul>	<del>OK</del> OK	GO to 2.3. Problem corrected. REPEAT test.
2.3	CHECK POWER TO FLASHER		
	<ul style="list-style-type: none"> <li>Check for power to the turn signal flasher. F-150 — F-350, F-Super Duty and Bronco Circuit No. 298 (P/O). E-150 — E-350 Circuit No. 8 (O/Y).</li> </ul>	<del>OK</del> OK	REPAIR feed circuit. GO to 2.4.
2.4	CHECK POWER TO SWITCH		
	<ul style="list-style-type: none"> <li>Check for power to turn signal switch (Lt. Blue wire). Circuit No. 44.</li> </ul>	<del>OK</del> OK	REPAIR circuit between turn signal flasher and switch (blue wire). Circuit No. 44. GO to 2.5.

CK6164-2E

## TURN SIGNAL LAMPS — ALL LAMPS INOPERATIVE (Cont'd.)

TEST STEP		RESULT	ACTION TO TAKE
<b>2.5</b>	<b>CHECK TURN SIGNAL SWITCH</b>		
<ul style="list-style-type: none"> <li>Connect 12-volt test lamp to a good ground and, with turn signal switch on, check for power out of switch:  E-150 — E-350 and F-150 — F-350 — F-Super Duty  LH Front — Circuit No. 3 (GR/W)  LH Rear — Circuit No. 283 (Y/BK)  RH Front — Circuit No. 2 (W/BK)  RH Rear — Circuit No. 282 (GR)  Bronco:  LH Front — Circuit No. 3 (LG/W)  LH Rear — Circuit No. 9 (LG/O)  RH Front — Circuit No. 2 (W/LB)  RH Rear — Circuit No. 5 (O/LB) <b>OR</b></li> <li>Check the turn signal switch by plugging a new unit into the main wiring harness.</li> </ul>		Switch is 	GO to 2.6.
		Switch is 	REPAIR or REPLACE turn signal switch.
<b>2.6</b>	<b>CHECK FOR POWER TO SOCKETS</b>		
<ul style="list-style-type: none"> <li>Check for power to bulb sockets with turn signal switch on:  E-150 — E-350 and F-150 — F-350 — F-Super Duty  LH Front — Circuit No. 3 (GR/W)  LH Rear — Circuit No. 283 (Y/BK)  RH Front — Circuit No. 2 (W/BK)  RH Rear — Circuit No. 282 (GR)  Bronco:  LH Front — Circuit No. 3 (LG/W)  LH Rear — Circuit No. 9 (LG/O)  RH Front — Circuit No. 2 (W/LB)  RH Rear — Circuit No. 5 (O/LB)</li> </ul>			REPAIR circuit(s) between turn signal switch and bulbs.
			CHECK all bulbs and assure good ground. REPEAT test.





CK6165-2F

## TURN SIGNAL LAMPS — ONE OR MORE LAMPS INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
3.0	VERIFY THE CONDITION		GO to 3.1.
3.1	CHECK FOR POWER TO SOCKETS		GO to 3.2.
	<ul style="list-style-type: none"> <li>Check for power to bulb socket(s) with turn signal switch on:  E-150 — E-350 and F-150 — F-350 — F-Super Duty  LH Front — Circuit No. 3 (GR/W)  LH Rear — Circuit No. 283 (Y/BK)  RH Front — Circuit No. 2 (W/BK)  RH Rear — Circuit No. 282 (GR)  Bronco:  LH Front — Circuit No. 3 (LG/W)  LH Rear — Circuit No. 9 (LG/O)  RH Front — Circuit No. 2 (W/LB)  RH Rear — Circuit No. 5 (O/LB)  NOTE: If one or both of the instrument panel bulbs do not flash, check for power to the bulbs, check the bulb, and/or ground.</li> </ul>	<div> <div>OK</div> <div>GO to 3.2.</div> </div> <div> <div>OK</div> <div>GO to 3.3.</div> </div>	
3.2	CHECK FOR POWER OUT OF SWITCH		REPAIR or REPLACE turn signal switch.
	<ul style="list-style-type: none"> <li>Connect 12-volt test lamp to a good ground and, with turn signal switch on, check for power out of switch:  E-150 — E-350 and F-150 — F-350 — F-Super Duty  LH Front — Circuit No. 3 (GR/W)  LH Rear — Circuit No. 283 (Y/BK)  RH Front — Circuit No. 2 (W/BK)  RH Rear — Circuit No. 282 (GR)  Bronco:  LH Front — Circuit No. 3 (LG/W)  LH Rear — Circuit No. 9 (LG/O)  RH Front — Circuit No. 2 (W/LB)  RH Rear — Circuit No. 5 (O/LB) OR</li> <li>Check the turn signal switch by plugging a new unit into the main wiring harness.</li> </ul>	<div> <div>Switch is</div> <div>OK</div> </div> <div> <div>Switch is</div> <div>OK</div> </div>	<div>REPAIR or REPLACE turn signal switch.</div> <div>REPAIR circuits between switch and bulb socket.</div>
3.3	CHECK FOR GROUND		REPAIR socket ground.
	<ul style="list-style-type: none"> <li>Check for ground to socket.</li> </ul>	<div>OK</div> <div>OK</div>	<div>REPAIR socket ground.</div> <div>REPLACE bulb.</div>





CK6167-2F

## ONE TURN SIGNAL LAMP DOES NOT LIGHT

TEST STEP		RESULT	ACTION TO TAKE
4.0	VERIFY THE CONDITION		GO to 4.1.
4.1	CHECK BULB		
	<ul style="list-style-type: none"> <li>Check bulb of inoperative turn signal lamp.</li> </ul>	 	REPLACE bulb. GO to 4.2.
4.2	CHECK POWER		
	<ul style="list-style-type: none"> <li>Check for power at bulb socket.</li> </ul>	 	REPAIR circuit from socket to turn signal switch. SERVICE ground to socket.

CK6751-2A

## HAZARD WARNING FLASHER LAMPS DO NOT TURN ON

TEST STEP		RESULT	ACTION TO TAKE
5.0	VERIFY CONDITION		GO to 5.1.
5.1	CHECK STOPLAMPS		
	<ul style="list-style-type: none"> <li>Check stoplamps and turn signal operations.</li> </ul>	 	REFER to turn signal diagnosis to resolve problem and/or SERVICE or REPLACE feed circuit or connections in fuse block or to fuse block. GO to 5.2.
5.2	CHECK CIRCUIT BETWEEN FUSE & FLASHER		
	<ul style="list-style-type: none"> <li>Check circuit between fuse and flasher connector, flasher and hazard flasher switch and between hazard flasher switch and bulb feed.</li> </ul>	 	REPAIR circuit wiring as required. CHECK hazard flasher switch, or turn signal switch, or turn signal switch assembly. SERVICE or REPLACE as required.

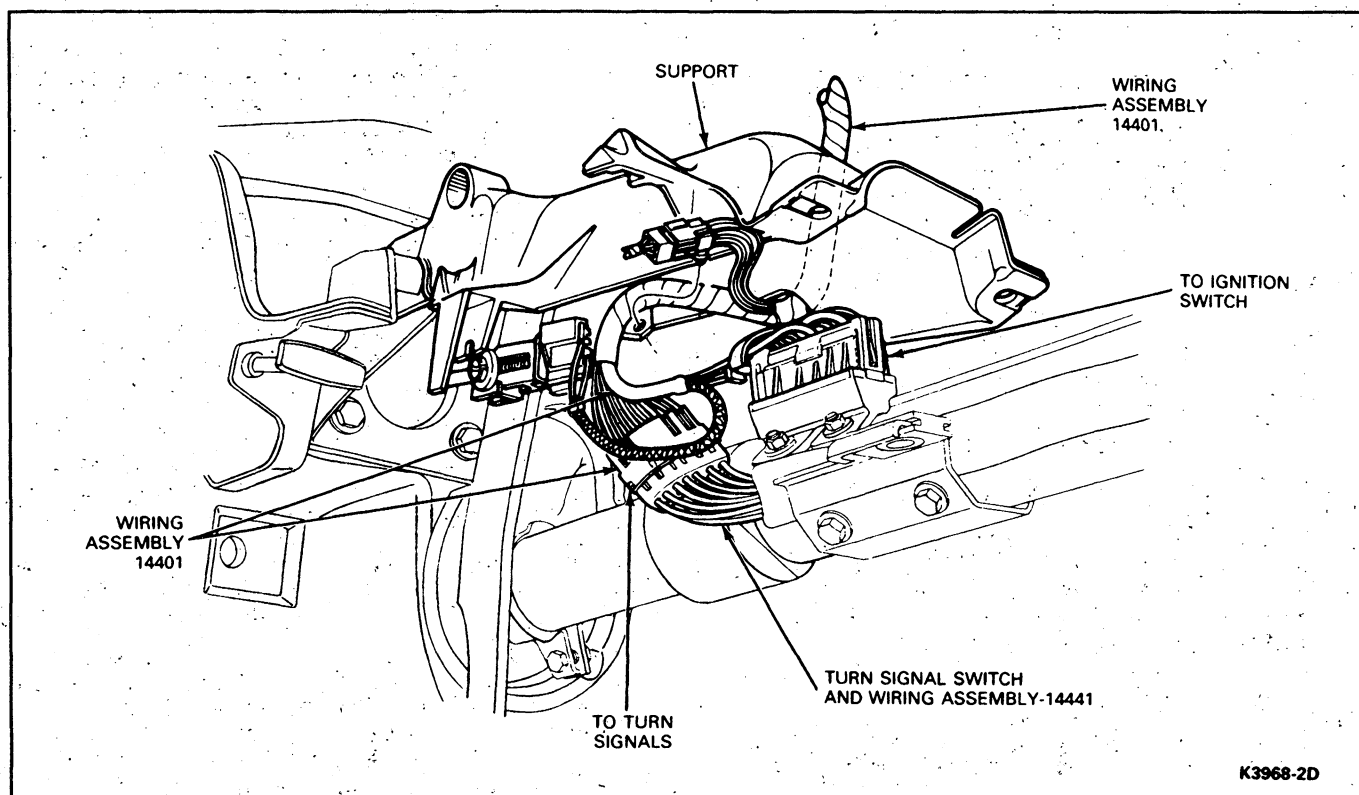
CK6172-2B



## REAR HAZARD WARNING FLASHER LAMPS DO NOT LIGHT

TEST STEP		RESULT	ACTION TO TAKE
7.0	VERIFY CONDITION		GO to 7.1.
7.1	CHECK REAR STOPLAMPS		
	<ul style="list-style-type: none"> <li>Check rear stoplamps. (Both rear stoplamps should light.)</li> </ul>	<div> <div>OK</div> <div>▶</div> </div>	SERVICE rear stoplamp circuit.
		<div> <div>OK</div> <div>▶</div> </div>	GO to 7.2.
7.2	CHECK TURN SIGNAL LAMPS		
	<ul style="list-style-type: none"> <li>Check turn-signal lamps.</li> <li>Check turn signal switch.</li> </ul>	Lamps <div> <div>OK</div> <div>▶</div> </div>	REPLACE switch.
		Switch <div> <div>OK</div> <div>▶</div> </div>	REPLACE lamp bulbs.

CK6170-2B



K3968-2D

FIG. 13 F-150—F-350—F-Super Duty and Bronco—Turn Signal Wiring

## REMOVAL AND INSTALLATION

## Turn Signal/Hazard Warning Flasher Switch

## F-150—F-350—F-Super Duty and Bronco

Refer to Fig. 13.

## Removal

1. Disconnect the battery ground cable.
2. Remove the horn switch.
3. Remove the steering wheel retaining nut. Using Steering Wheel Removal Tool T67L-3600-A or equivalent remove steering wheel from shaft.
4. Remove the turn signal switch lever by unscrewing it from the steering column.
5. Remove the steering column shroud.
6. Disconnect the turn indicator switch wiring connector plug by lifting up on the tabs and separate. Remove the screws that secure the switch assembly to the column.
7. On vehicles with a fixed column, remove the switch assembly from vehicle by lifting it out of the column and guiding the connector plug through the opening in the shift socket.

Vehicles equipped with tilt columns require removal of the connector plug (Figs. 14 and 15) prior to removing the switch assembly from the column. (The opening in the shift socket provided for the wiring harness is not large enough for the connector to pass through.)

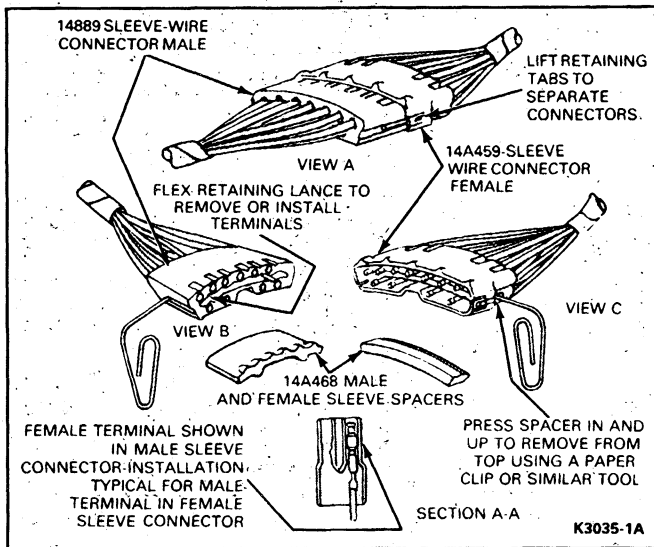


FIG. 14 Wire Connector—Removal

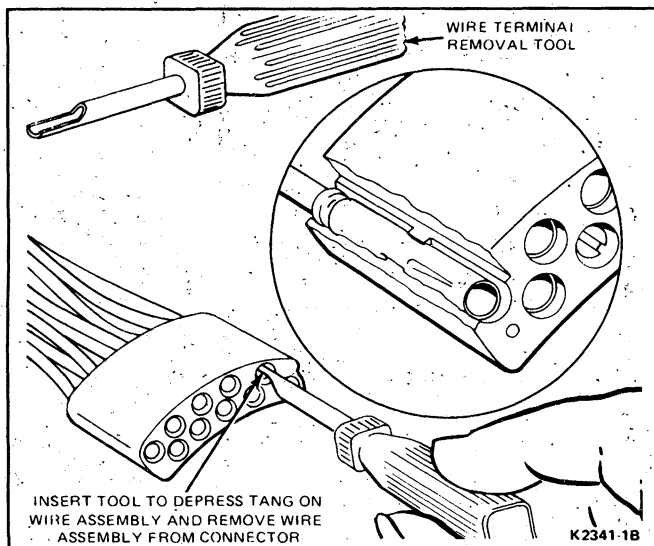


FIG. 15 Wire Terminal Removal—Tilt Only

### Installation

1. Guide the turn signal switch wiring harness through the opening provided in the shift socket.
2. Install switch assembly retaining screws to column.
3. Install wires into the steering column connector terminal on vehicles equipped with tilt columns.
4. Plug turn signal switch harness connector into main wiring harness.
5. Install the steering column shroud.
6. Install turn signal lever. Hand tighten the lever (on flat side) to 1.2-2.25 N·m (10-20 in-lb).
7. Install steering wheel and retaining nut. Tighten wheel nut to 41-54 N·m (30-40 ft-lb).
8. Install horn switch.
9. Connect the battery ground cable.

### E-150—E-350

Refer to Fig. 16.

### Removal

1. Disconnect the battery ground cable.
2. Remove the horn switch.
3. Remove the steering wheel retaining nut. Using Steering Wheel Removal Tool T67L-3600-A or equivalent, remove steering wheel from shaft.
4. Remove the turn signal switch lever by unscrewing it from the steering column.
5. Remove steering column shroud and instrument panel steering column opening cover.
6. Disconnect the turn signal indicator switch wiring connector plug by lifting up on the tabs and separate. Remove the screws that secure the switch assembly to the column.
7. Fixed Column:

Remove PRNDL lamp assembly from the shift socket on vehicles equipped with an automatic transmission.

The turn signal switch assembly and PRNDL lamp harness can now be removed from the steering column by lifting out of the column and guiding the connector plug through the openings in the brake and clutch pedal support bracket and the shift socket.

If the turn signal switch assembly is to be replaced, the connector plug must be disassembled (Figs. 14 and 15) to remove the PRNDL lamp and attaching harness.

The PRNDL lamp is not serviced with the new turn signal switch assembly and must be reused with replacement turn signal switch assembly.

8. Tilt Column:

Vehicles equipped with a tilt column require disassembly of the turn signal switch harness plug (Figs. 14 and 15) prior to removal of the switch assembly from the column. (The opening in the shift socket provided for the wiring harness is not large enough for the connector plug to pass through.)

Vehicles equipped with automatic transmissions also require removal of the PRNDL lamp wire from the turn signal switch harness sheath prior to removal of the switch assembly from the column. The PRNDL lamp harness assembly can remain attached to the column when the turn signal switch is serviced.

NOTE: The PRNDL lamp used in the tilt automatic transmission column is serviced in the lamp harness assembly. The bulb cannot be serviced separately.

### Installation

1. Guide the turn signal switch wire harness through the openings provided in the shift socket and the LH side of the brake and clutch pedal support bracket.
2. On vehicles equipped with an automatic transmission, insert the PRNDL lamp wire into the turn signal switch harness sheath.
3. Install turn signal switch assembly retaining screws.
4. Assemble wires into connector plug on vehicles equipped with tilt column.



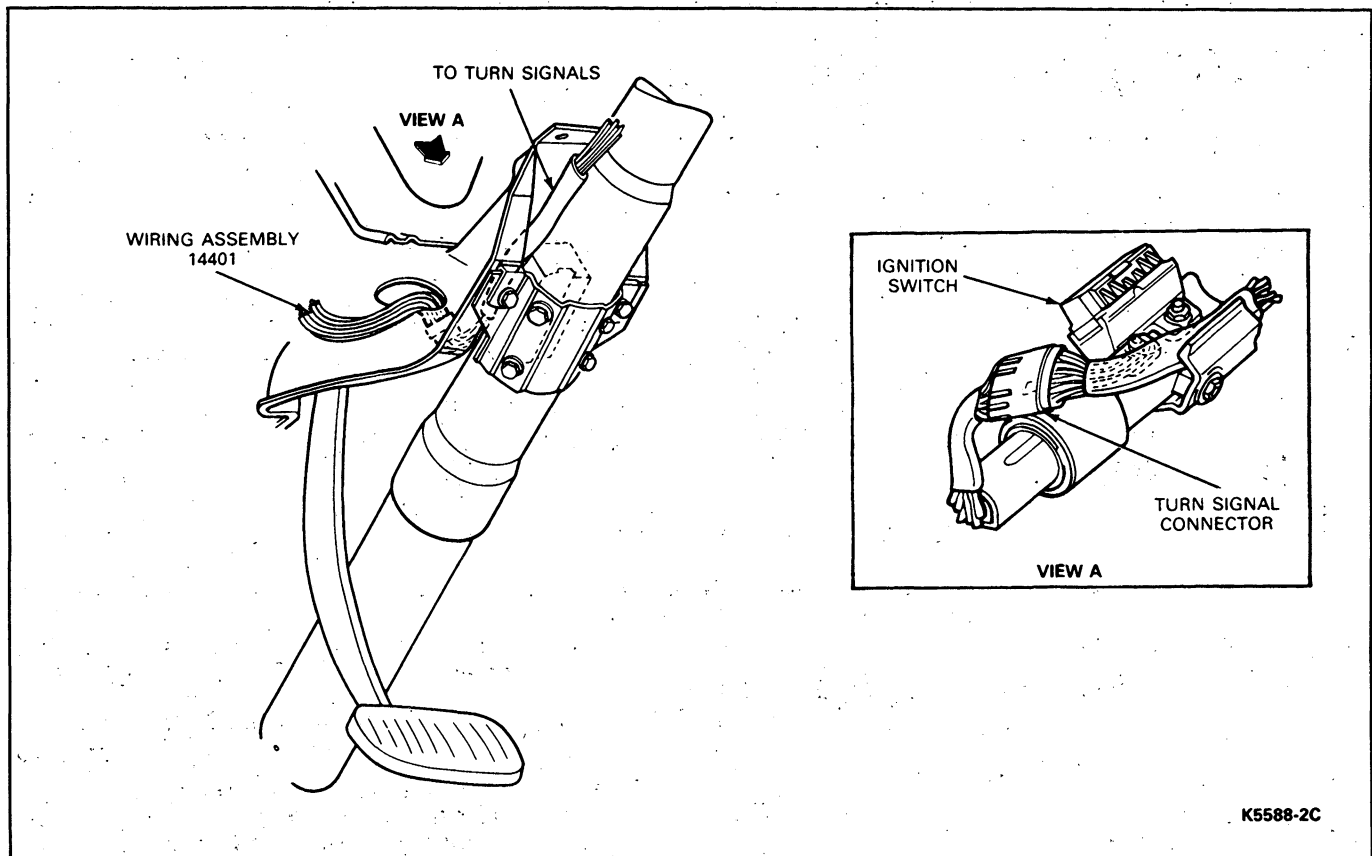


FIG. 16 E-150—E-350—Turn Signal Wiring

NOTE: The color code sequence for this connector does not coincide with the color code of the wires in the harness connector plug. The correct color code sequence is shown in the Wiring Diagram Manual.

5. Plug the switch harness into the main wiring harness. Ensure vinyl sleeve on switch harness covers all harness wires where they pass through the opening in the LH side of the brake and clutch pedal support bracket. If necessary, slide the vinyl sleeve down the switch harness toward the harness connector so that the sleeve protrudes through the opening.
6. Install the turn signal lever. Tighten lever to 1.2-2.25 N·m (10-20 in-lb).
7. Install steering wheel and retaining nut. Tighten wheel nut to 41-54 N·m (30-40 ft-lb).
8. Install horn switch.
9. Install steering column shroud and instrument panel steering column opening cover.
10. Connect battery ground cable.

## Flasher Units

### Removal and Installation

To remove a flasher unit from F-150-F-350—F-Super Duty trucks and Bronco, grasp flasher and pull straight out. To replace flasher, align flasher terminals to fuse panel and push straight in (Fig. 2). For E-150—E-350, twist the flasher unit 90 degrees counterclockwise,

remove and disconnect the wiring connector. Install by connecting the connector and inserting the flasher unit into the retaining hole. Twist 90 degrees clockwise (Fig. 1).

**When replacing a turn signal flasher unit, ensure the new flasher unit has the same color code and number as the one removed.**

NOTE: Do not replace turn signal switch or wiring if:

- Turn signal lamps do not flash on demand with ignition key turned on, and
  - Turn signal flasher makes normal pulsing noise, and
  - Turn signal lamps prove satisfactory when bench-tested or checked by activating brake stoplamp switch for rear only.
1. Check for power at the turn signal flasher output connector (pulsing noise indicates power is coming into the flasher).
  2. If there is **no or very weak power** at the flasher output connector (12-volt test lamp will not light or is dim), **replace the turn signal flasher.**

## SPECIAL SERVICE TOOLS

Tool Number	Description
T67L-3600-A	Steering Wheel Removal

CK6196-1B

## SECTION 32-61 Interior Lamps

SUBJECT	PAGE	SUBJECT	PAGE
<b>DESCRIPTION AND OPERATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Dome and Map Lamp Combination— F-150—F-350 Super Cabs, F-Super Duty and Bronco .....	32-61-1	Cargo Lamp (Cont'd)	
Engine Compartment Lamp .....	32-61-1	F-150—F-350—F-Super Duty .....	32-61-1
Interior Lamps .....	32-61-1	Courtesy Lamp Switch—Door Jamb .....	32-61-4
E-150—E-350 .....	32-61-1	Dome Lamp .....	32-61-1
F-150—F-350—F-Super Duty and Bronco .....	32-61-1	Bronco .....	32-61-1
<b>REMOVAL AND INSTALLATION</b>		Engine Compartment Lamp .....	32-61-4
Cargo Lamp .....	32-61-1	E-150—E-250 (Optional) .....	32-61-4
Bronco .....	32-61-4	<b>VEHICLE APPLICATION</b> .....	32-61-1

### VEHICLE APPLICATION

All E150-E350, F-150-F-350, F-Super Duty and Bronco Models.

### DESCRIPTION AND OPERATION

#### Interior Lamps

##### E-150—E-350

The overhead dome lamp, map-dome lamp, and cargo lamp for E-150—E-350 (Fig. 1) are controlled by the headlamp switch and switches located in the door jams.

The bulbs are energized when the headlamp switch knob is turned fully counterclockwise and also when the door is opened.

##### F-150—F-350—F-Super Duty and Bronco

The overhead dome lamp and map-dome lamp are located above the rear window on regular cab F-150—F-350—F-Super Duty and is located above the rear of the front seat on Super Cab and Bronco. The bulbs are energized when the headlamp switch knob is turned fully counterclockwise (Figs. 2, 3 and 4).

All models of the F-150 through F-350—F-Super Duty, Bronco, and Econoline are equipped with door jamb switches which also control the dome lamp (Fig. 5).

The cargo lamp on F-150 through F-350—F-Super Duty and Super Cab series is located above the rear window (Fig. 7) and is controlled by the headlamp switch being turned fully counterclockwise.

The cargo lamp and switch for Bronco vehicles is located at the rear left side of the cargo area (Fig. 8).

The engine compartment lamp is located on the bottom center of the hood and is energized when the hood is raised.

The courtesy lamps for the Bronco and F-150 through F-350, F-Super Duty are located under the instrument panel on the RH and LH sides (Fig. 6). These lamps are energized by door jamb switches and by turning the headlamp switch fully counterclockwise.

The glove compartment lamp is energized by opening the glove compartment door (Fig. 6).

#### Dome and Map Lamp Combination—F-150—F-350 Super Cabs, F-Super Duty and Bronco

The two map lamps are located on each side of the dome lamp housing (Figs. 3 and 4). The map lamps are operated independently of the dome lamp by two switches located at each map lamp housing. The dome lamp is actuated by turning the headlamp switch control knob fully counterclockwise. The dome lamp is also energized by a switch in the pillar when the doors are opened.

#### Engine Compartment Lamp

E-150—E-250 models may be equipped with an optional engine compartment lamp. The lamp is mounted to the hood in the engine compartment.

### REMOVAL AND INSTALLATION

#### Dome Lamp

##### Bronco

Carefully pry the dome lamp lens at the corners from the housing (Fig. 3). Remove the two screws retaining the map lamp lens housing to the lamp base and remove the bulbs. To remove the lamp base, remove the four retaining screws. To install, reverse procedure.

##### F-150—F-350—F-Super Duty and E-150—E-350

To replace bulb, snap lens out of lamp body and remove bulb from retainers (Figs. 1 and 2).

To remove lamp body, remove four retaining screws.

To install, position lamp body over screw holes and install four screws. Push on lens to snap into position.

#### Cargo Lamp

##### F-150—F-350—F-Super Duty

To remove the cargo lamp assembly on the F-150 through F-350 Super Cab and F-Super Duty series trucks, remove the two lens and door retaining screws and remove the lamp assembly (Fig. 8). To install, reverse procedure.

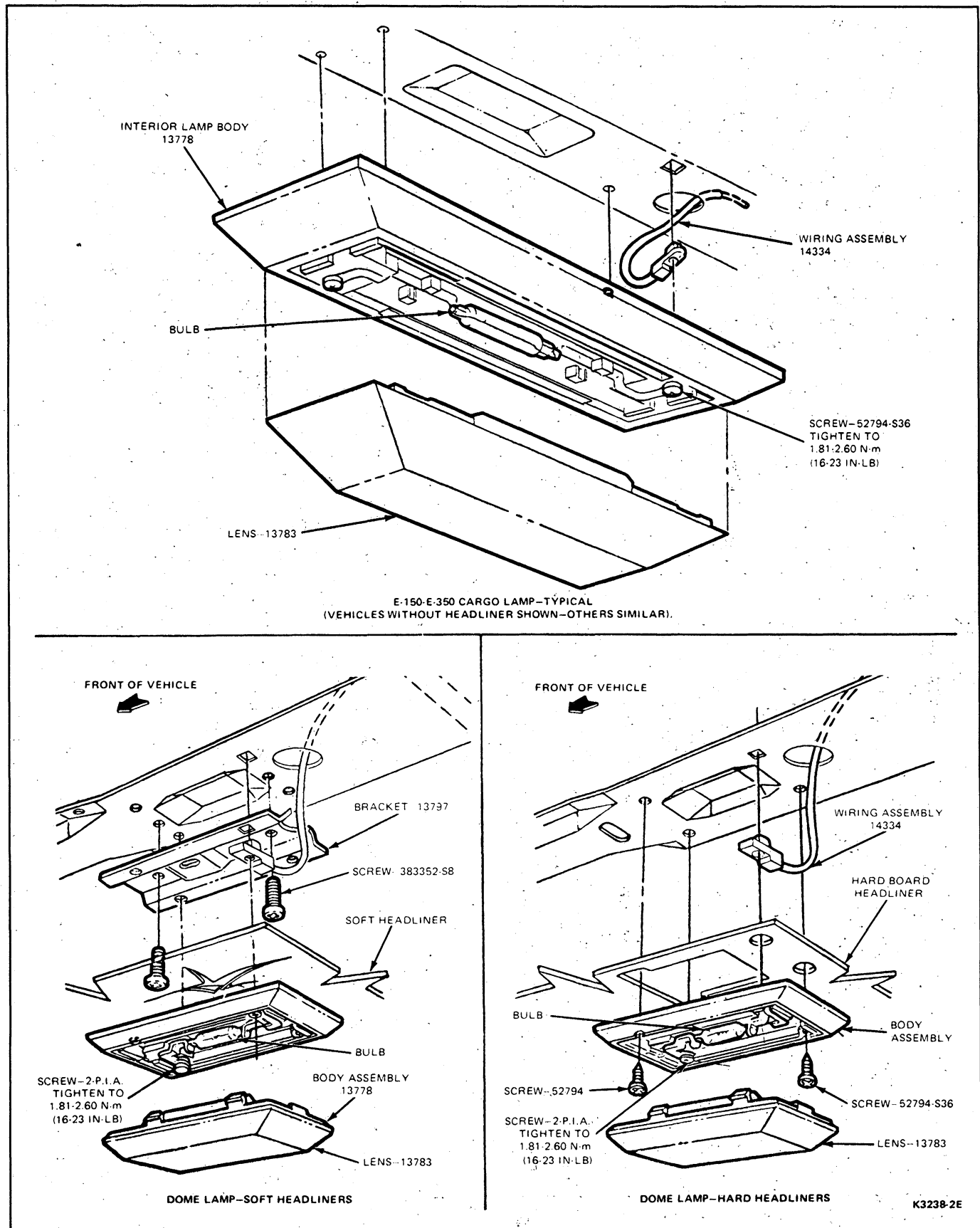


FIG. 1 E-150-E-350 Dome and Cargo Lamp—Typical

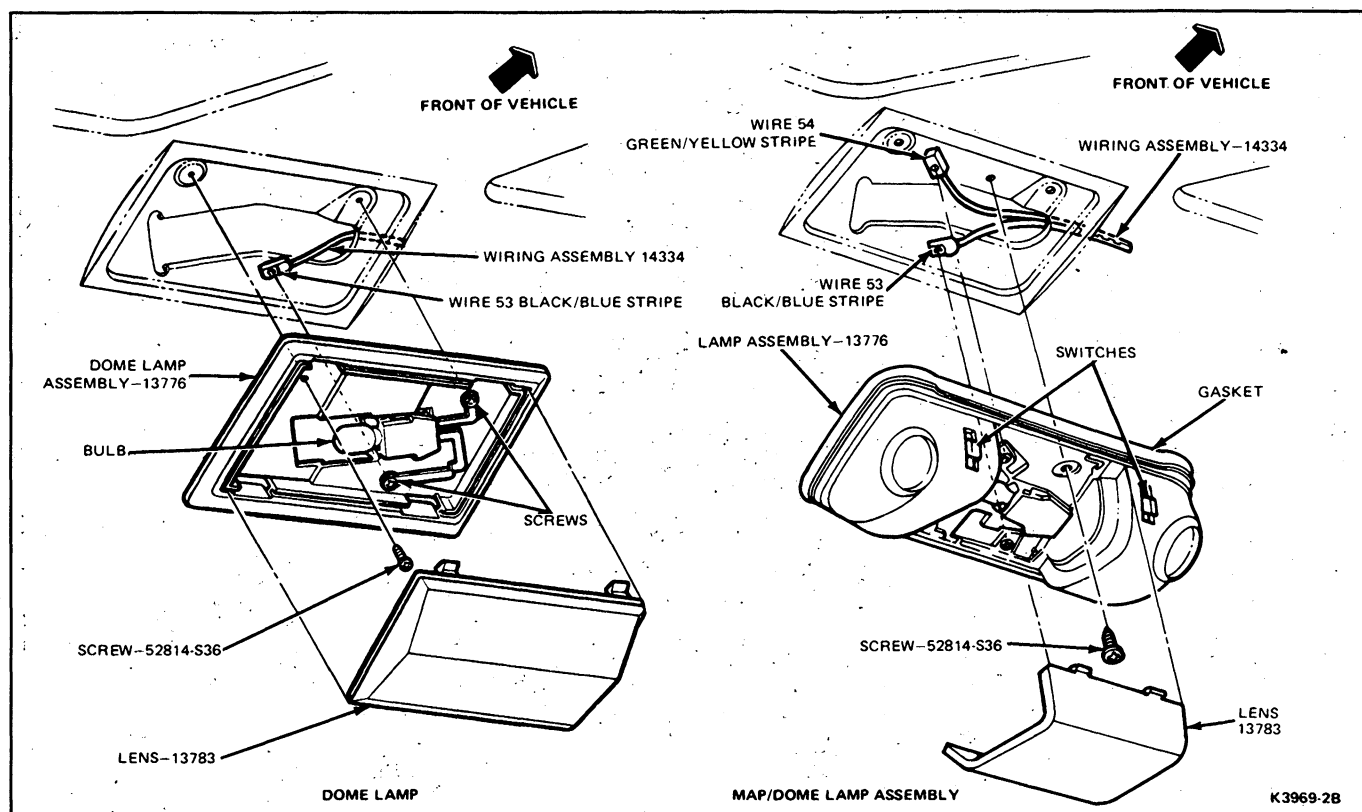


FIG. 2 Map/Dome Lamp—F-150—F-350—F-Super Duty

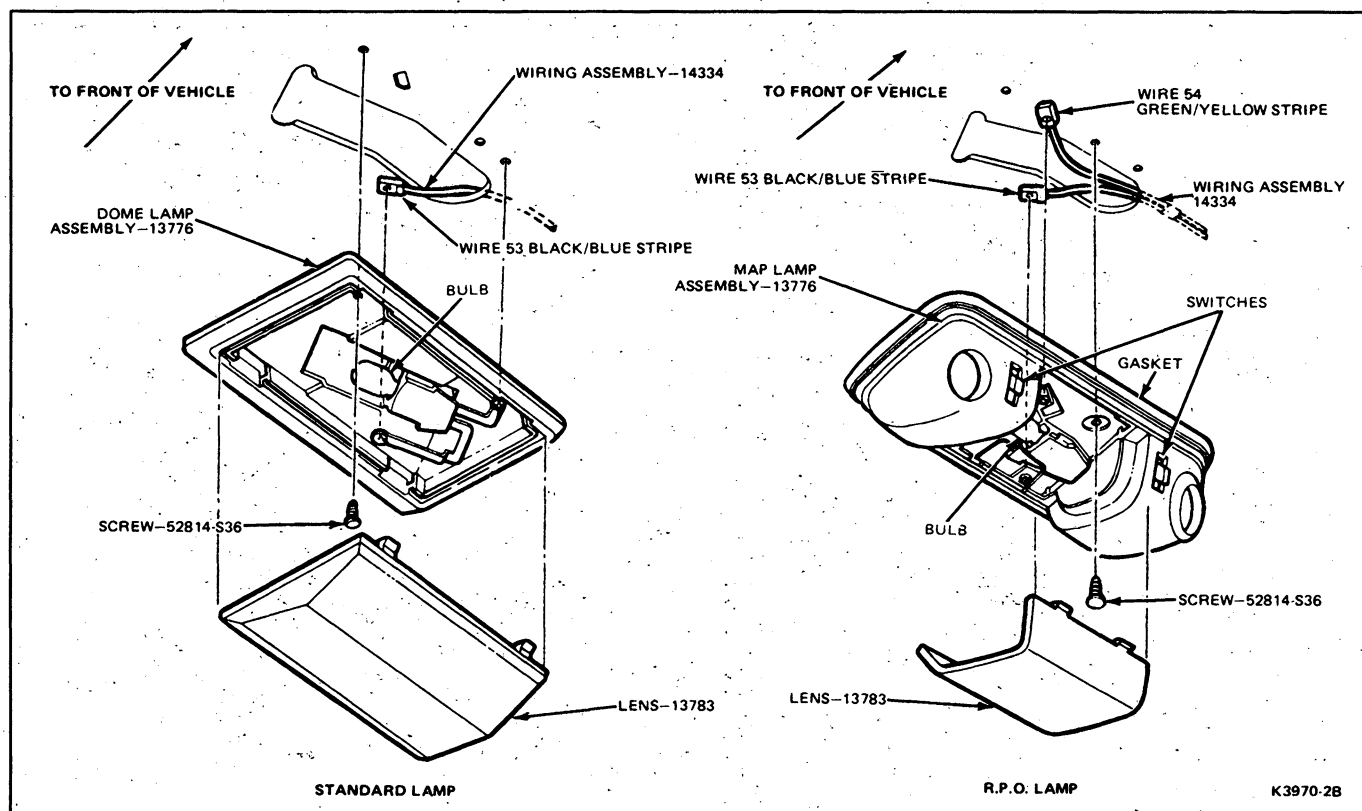


FIG. 3 Map/Dome Lamp—Bronco—Without Headliner Shown

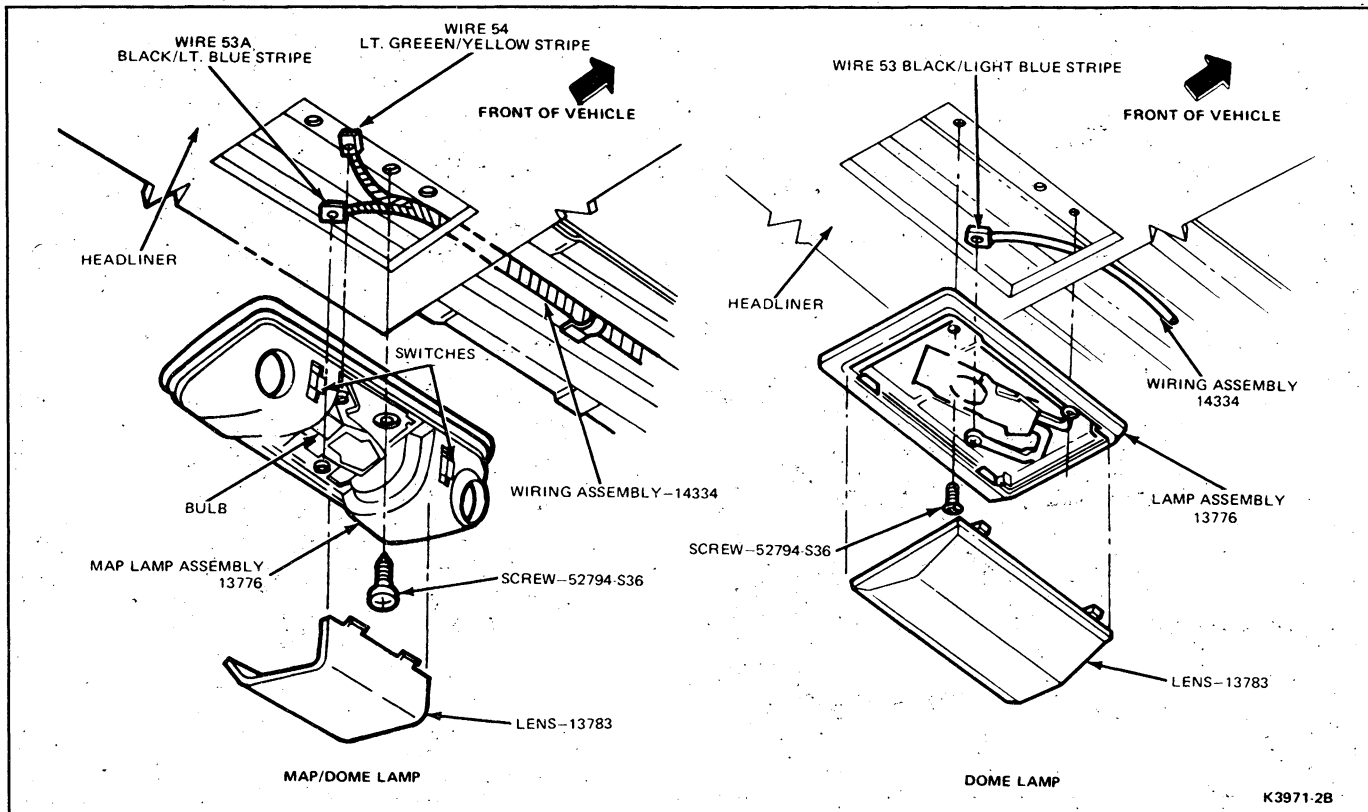


FIG. 4 Map Lamp—F-150—F-350—Super Cab, F-Super Duty

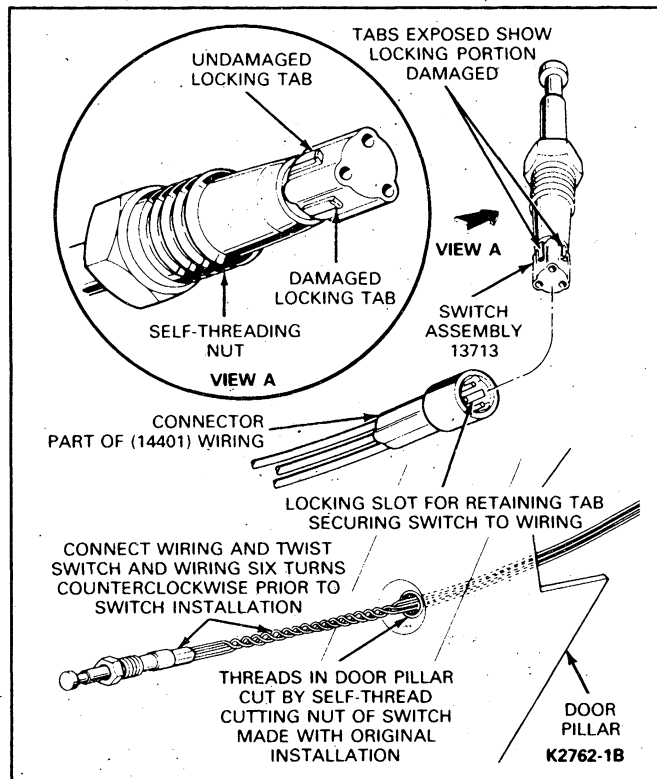


FIG. 5 Courtesy Lamp Switch Installation

On the E-150—E-350, unsnap the lens, remove the two lamp body attaching screws. Disconnect the wiring assembly and remove the lamp body (Fig. 1). To install, reverse procedure.

### Bronco

On Bronco vehicles, carefully unsnap cargo lamp assembly from side of vehicle. Disconnect wiring assembly and remove lamp body (Fig. 8). To install, reverse procedure.

### Courtesy Lamp Switch—Door Jamb

#### Removal

Unscrew the hex sleeve nut from the pillar. Extract switch and pull the wiring connector off the switch (Figs. 5 and 6).

Retention of courtesy lamp switch to the (14401) wiring connector is by one of three tabs positioned 120 degrees apart on the switch. If, when the switch is disconnected from the wiring connector, the engaged locking tab breaks off, the switch must be rotated 120 degrees to engage a new tab. When all three tabs have been broken, the switch must be replaced (Fig. 5).

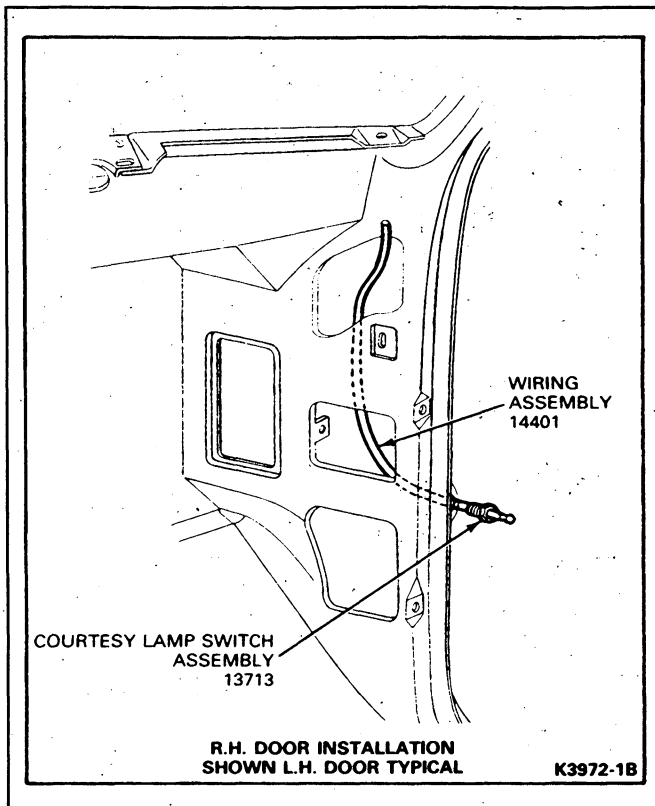
#### Installation

To install the switch in the pillar, pull the wiring connector and wiring through the switch mounting hole in the pillar and connect the switch to the connector (Fig. 5). Then, twist the wiring and switch 4-1/2 turns counterclockwise, push the wiring and connector back through the mounting hole. Screw the switch into the pillar until it is seated. Close and open the door to ensure the courtesy lamp is operating properly.

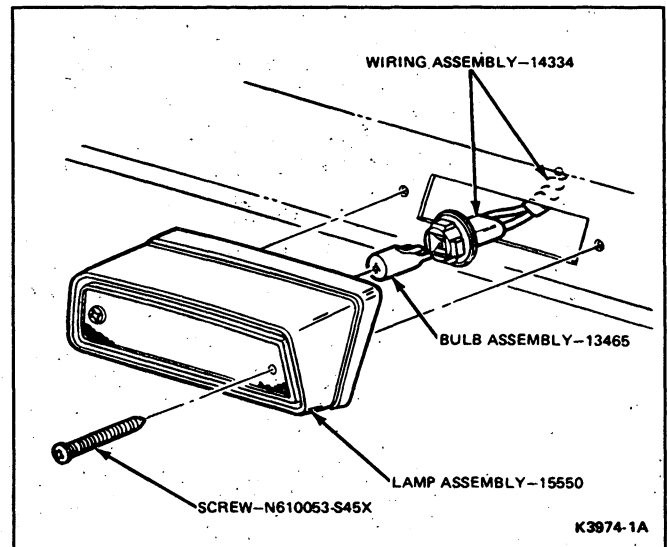
### Engine Compartment Lamp

#### E-150—E-250 (Optional)

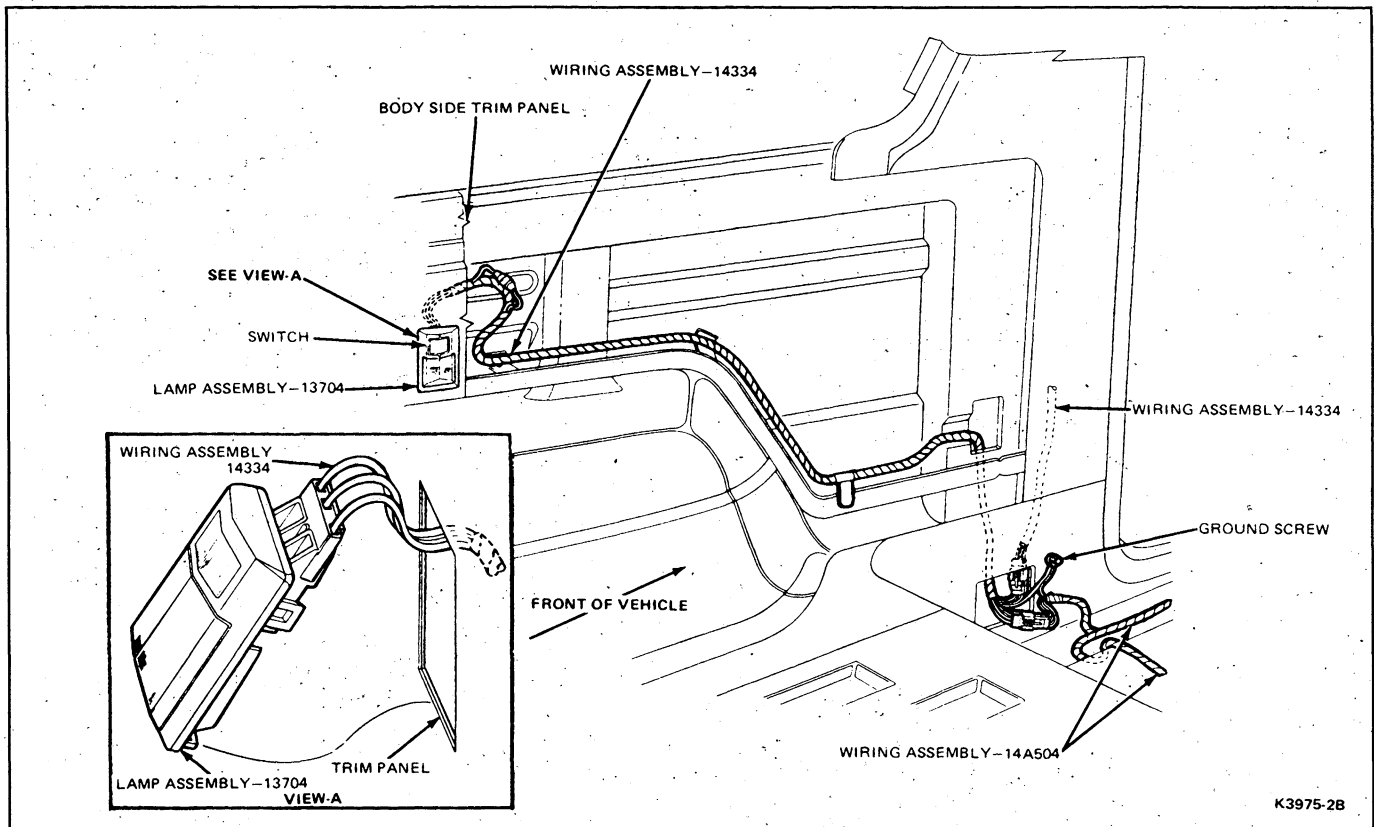
Bulb replacement requires only removal of the bulb and installation of the new bulb. No lens or door is used on the engine compartment lamp.



**FIG. 6 Bronco and F-150 Through F-350—F-Super Duty Courtesy Lamps and Wiring**



**FIG. 7 Cargo Lamp—F-150—F-350 and Super Cab, F-Super Duty**

**FIG. 8 Cargo Lamp—Bronco**

# INSTRUMENTS, CLUSTER AND CONTROLS

## GROUP 33

SECTION TITLE	PAGE	SECTION TITLE	PAGE
CHARGE INDICATOR—AMMETER .....	33-12-1	OIL PRESSURE GAUGE .....	33-32-1
CHARGE INDICATOR—LAMP .....	33-10-1	SHIFT INDICATOR LAMP .....	33-15-1
FUEL INDICATING SYSTEM .....	33-20-1	SPEEDOMETER .....	33-02-1
IGNITION SWITCH .....	33-71-1	TACHOMETER .....	33-04-1
INSTRUMENT CLUSTER AND PRINTED CIRCUIT .....	33-51-1	TACHOMETER 7.3L DIESEL .....	33-06-1
		TEMPERATURE INDICATOR .....	33-41-1

## SECTION 33-02 Speedometer

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION	
Speedometer System .....	33-02-1	Speedometer Core—17262 .....	33-02-7
DIAGNOSIS AND TESTING		Speedometer Head .....	33-02-2
Speedometer .....	33-02-1	F-150 Through F-350, F-Super Duty, Bronco and E-150—E-350 .....	33-02-2
Speedometer Cable and Core .....	33-02-1	VEHICLE APPLICATION .....	33-02-1
Speedometer Accuracy Test .....	33-02-1		
DIAGNOSIS GUIDES .....	33-02-2		

### VEHICLE APPLICATION

Bronco, F-150 Through F-350, F-Super Duty and E-150 Through E-350.

### DESCRIPTION AND OPERATION

#### Speedometer System

The speedometer is connected to the output shaft of the transmission by means of a flexible shaft (core), and a drive gear located inside the transmission. The core drives the speedometer and the odometer. (Figs. 1, 2 and 3). All vehicles equipped with the 4.9L EFI, 5.0L EFI or 5.8L EFI engines have a speed sensor attached to the transmission. This is used to sense vehicle speed required for the engine management system and/or to regulate the speed control system for vehicles so equipped (Figs. 2 and 3). Refer to Section 37-01, Speed Control System.

### DIAGNOSIS AND TESTING

#### Speedometer Accuracy Test

To test the odometer accuracy, drive the vehicle over a measured mile. Speedometer accuracy can be checked by timing the vehicle on a measured mile. Refer to the Ford Truck Master Parts Catalog for the proper speedometer gears to use for various rear axle ratio and tire size combinations.

#### Speedometer

Before removing a speedometer head, if possible, disconnect the cable at the head and insert a short section of cable core in the head. Rotate the section of core to check for any dragging or noise. If the rotation drags, is noisy, or does not turn freely and evenly, replace the speedometer.

#### Speedometer Cable and Core

1. Visually inspect the speedometer cable for kinks, cuts, burrs, abrasion or severe bends behind the instrument panel due to the cable being trapped on



the brake/clutch pedal support bracket. If evidence of any such damage is observed, replace the speedometer cable.

2. Check the speedometer cable function as follows:
  - a. Disconnect the speedometer cable at the speedometer head.
  - b. Raise rear wheels, start the engine and check the speedometer core rotation at the meter end.
  - c. If the core does not rotate, disconnect the cable from the transmission end.
  - d. Twist core. If it will not rotate or is binding, replace the speedometer cable.
  - e. Examine the driven gear. A scored, nicked or gouged driven gear is usually indicative of a damaged drive gear on those vehicles that have the driven gear integral with the transmission output shaft. The output shaft should be carefully inspected for imperfections and replaced if necessary. A driven gear with two or three adjoining teeth badly scored is indicative of improper assembly procedure. The gear should be inserted in the transmission while simultaneously turning the drive shaft. This will ensure initial engagement and prevent gear damage. Force should never be used. Whenever a drive gear is replaced, a new driven gear should also be installed regardless of its apparent condition.
  - f. Examine the core tip for breaking or fraying. If damaged, replace.

## DIAGNOSIS GUIDES

If the speedometer is noisy, erratic, inoperative or inaccurate, refer to the following Diagnosis Guides.

## REMOVAL AND INSTALLATION

### Speed Sensor

#### Removal

1. Separate the electrical connector to the speed sensor on the transmission/transfer case.
2. Disconnect speedometer cable from speed sensor.
3. Remove retaining screw/nut.
4. Remove speed sensor.
5. Remove drive gear.

#### Installation

1. Install drive gear on speed sensor as identified in Figs. 1 and 2, View W.
2. Install speed sensor in transmission/transfer case.
3. Install retaining screw/nut.
4. Connect speedometer cable.
5. Connect electrical connector.

### Speedometer Head

**F-150 Through F-350, F-Super Duty, Bronco and E-150—E-350 (Figs. 1, 2 and 3)**

#### Removal

1. Remove instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit.

2. Remove speedometer cable (Fig. 4).
3. Remove lens and mask from the cluster, where applicable. Remove two speedometer attaching screws (Fig. 4).
4. Remove speedometer.

#### Installation

Position the speedometer to the back plate and install the two attaching screws. Install the mask and lens, then the instrument cluster. If a new speedometer is being installed, examine the square drive hole for sufficient lubrication. If lubrication is needed, apply a 4.8mm (3/16 inch) diameter dab of Silicone Grease per Ford Specification ESF-M1C134-A or equivalent, in the drive hole. Connect speedometer cable as outlined.

### Econoline E-150 Through E-350, F-Super Duty

#### Removal

1. Raise vehicle on a hoist.
2. Disengage speedometer cable clamp and remove cable assembly from transmission (Fig. 3).  
NOTE: On vehicles equipped with a transmission-mounted speed sensor, remove the speedometer cable by pulling it out of the speed sensor. Do not attempt to remove the spring retainer clip with the speedometer cable in the sensor. To install the speedometer cable, align the core with the sensor and snap cable assembly into the speed sensor.
3. Disengage all remaining cable clips.
4. Push cable and grommet through floorpan opening into cab (Fig. 3).
5. Remove retainer holding cable clip to brake and clutch pedal support.
6. Disconnect speedometer cable from speedometer (Fig. 4).

#### Installation

1. Connect speedometer cable to speedometer head (Fig. 4).
2. Route cable through floorpan opening.
3. Attach cable clip to brake and clutch pedal support.
4. Press grommet into floorpan opening.
5. Raise vehicle on a hoist.
6. Lubricate cable core exposed at transmission ferrule with Speedometer Cable Lubricant D2AZ-19581-A (ESF-M1C160-A) or equivalent.
7. Apply a coating of Ford Polyethylene Grease D0AZ-19584-A (ESR-M1C159-A) or equivalent, to O-ring on ferrule.
8. Lubricate ID and teeth of driven gear with Speedometer Cable Lubricant D2AZ-19581-A (ESF-M1C160-A) or equivalent. Install driven gear on ferrule.
9. Assemble driven gear retainer to driven gear with retainer tabs toward gear teeth (Fig. 3).
10. Insert driven gear and cable into transmission. Retain by tightening retaining screw to 2.25-2.82 N·m (20-25 in-lb).
11. Secure cable with clips/clamps at locations indicated by tape on cable.

**SPEEDOMETER IS NOISY**

TEST STEP		RESULT	ACTION TO TAKE
<b>1.0</b>	<b>DURING CHECKOUT SPEEDOMETER IS NOISY</b>		
<b>1.1</b>	<b>CHECK CONNECTIONS</b>		
	<ul style="list-style-type: none"> <li>Check quick connect speedometer head for proper attachment.</li> </ul>	All connections are good One or more connections bad	GO to 1.2. REPAIR or REPLACE bad connection. CHECK for noise.
<b>1.2</b>	<b>VERIFY CONDITION WITH ENGINE RUNNING IN NEUTRAL</b>		
	<ul style="list-style-type: none"> <li>With engine running and vehicle in NEUTRAL check for noise.</li> </ul>	Noise is still present Noise is not present	CHECK for other cause of vehicle noise. GO to 1.3.
<b>1.3</b>	<b>CHECK SENSOR</b>		
	<ul style="list-style-type: none"> <li>Check sensor for erratic or noisy operation.</li> </ul>	Sensor OK Sensor not OK	GO to 1.4. REPLACE sensor. CHECK system for noise.
<b>1.4</b>	<b>CHECK CABLE (IF APPLICABLE)</b>		
	<ul style="list-style-type: none"> <li>Check cable for any kinks or bends.</li> </ul>	Cable is OK Cable is not OK	GO to 1.5. If kinks are severe, REPLACE cable. For minor bends, ADJUST cable routing to obtain generous curves and CHECK for proper connection.
<b>1.5</b>	<b>CHECK CORE</b>		
	<ul style="list-style-type: none"> <li>Disconnect cable and check core for kinks, burrs or bent tips.</li> </ul>	Core is not OK Core is OK	REPLACE core. CHECK system for noise. GO to 1.6.
<b>1.6</b>	<b>LUBRICATE SHAFT END</b>		
	<ul style="list-style-type: none"> <li>Put daub of lube on end of shaft.</li> </ul>	Noise remains Noise is gone	GO to 1.7. Condition corrected.
<b>1.7</b>	<b>CHECK GEAR(S)</b>		
	<ul style="list-style-type: none"> <li>Check for damaged or worn driven gear(s).</li> </ul>	Gear(s) are good Damaged gear(s)	REPLACE speedometer head. CHECK system. REPLACE gear(s) as required. CHECK system.

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**SPEEDOMETER IS ERRATIC OR POINTER WAVERS**

TEST STEP		RESULT	ACTION TO TAKE
<b>2.0</b>	<b>DURING CHECKOUT, SPEEDOMETER ACTS ERRATICALLY OR POINTER WAVERS</b>		
<b>2.1</b>	<b>CHECK CONDITIONS</b>		
	<ul style="list-style-type: none"> <li>Ensure quick connect is properly attached at speedometer head.</li> </ul>	All connections are good →  One or more connections are bad →	GO to 2.2.  REPAIR or REPLACE bad connections. CHECK for erratic or wavering pointer.
<b>2.2</b>	<b>CHECK CABLE</b>		
	<ul style="list-style-type: none"> <li>Check speedometer cable for kinks or bends in the routing.</li> <li>While cable is disconnected at transmission, check drive tip square for wear.</li> </ul>	Cable and drive tip OK → ✗ →	GO to 2.3.  If kinks are severe, REPLACE cable. For minor bends, ADJUST cable routing to obtain generous curves, and CHECK for proper connection. If drive tip is worn, REPLACE cable.
<b>2.3</b>	<b>CHECK DRIVEN GEAR</b>		
	<ul style="list-style-type: none"> <li>Check driven gear for damage, wear or use of incorrect parts.</li> </ul>	✗ →  OK →	REPLACE driven gear. CHECK speedometer.  GO to 2.4.
<b>2.4</b>	<b>CHECK CORE</b>		
	<ul style="list-style-type: none"> <li>Disconnect cable and check core for kinks, burrs, or bent tips.</li> </ul>	✗ →  OK →	REPLACE core. CHECK speedometer.  GO to 2.5.
<b>2.5</b>	<b>CHECK CORE (CONTINUED)</b>		
	<ul style="list-style-type: none"> <li>Install core and turn by hand to feel for rough or irregular motion.</li> </ul>	✗ →  OK →	REPLACE core. CHECK speedometer.  REPLACE speedometer head. CHECK speedometer.

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NOTE: The speedometer cable routing should avoid sharp bends; the cable should be straight for approximately 203mm (8 inches) from speedometer.

12. Lower vehicle.





**Speedometer Cable 17260****F-150 Through F-350 and Bronco****Removal**

1. Raise vehicle on a hoist.
2. Disengage speedometer cable clamp and remove cable assembly from transmission (Figs. 1 and 2).

3. Disengage all remaining cable clips.
4. Remove screw holding cable clip to steering column bracket.
5. Push cable and grommet through floorpan opening into cab. (Figs. 1 and 2).
6. Lower vehicle.
7. Remove instrument cluster. Refer to Section 33-51, Instrument cluster and Printed Circuit. Disconnect speedometer cable from speedometer (Fig. 4).



NOTE: On vehicles equipped with transmission-mounted speed sensor, remove speedometer

**SPEEDOMETER IS INOPERATIVE**

<b>TEST STEP</b>		<b>RESULT</b>	<b>ACTION TO TAKE</b>
<b>3.0</b>	<b>DURING CHECKOUT, SPEEDOMETER IS INOPERATIVE</b>		
<b>3.1</b>	<b>CHECK CONNECTIONS</b>		
	<ul style="list-style-type: none"> <li>• Verify quick connect is properly attached at speedometer head.</li> <li>• Check drive tip at transmission end of cable to make sure it is properly seated in driven gear.</li> <li>• Check drive gear and driven gear for damage or wear.</li> </ul>	<p>All connections are good</p> <p>One or more connections are bad or drive tip not seated properly</p>	<p>GO to 3.2.</p> <p>REPAIR tighten sensor or REPLACE bad connections. CHECK to see if speedometer is now operative.</p>
<b>3.2</b>	<b>CHECK ODOMETER</b>		
	<ul style="list-style-type: none"> <li>• Check operation of odometer.</li> </ul>	<p>Odometer is operating</p> <p>Speedometer pointer operates but odometer does not operate</p> <p>If both odometer and speedometer pointer fail to operate</p>	<p>REPLACE speedometer head. CHECK speedometer for operation.</p> <p>REPLACE speedometer head. CHECK speedometer for operation.</p> <p>GO to 3.3.</p>
<b>3.3</b>	<b>CHECK SPEEDOMETER HEAD</b>		
	<ul style="list-style-type: none"> <li>• Disconnect cable and check that magnet shaft in speedometer head turns freely by rotating with a short section of cable core.</li> </ul>	<p></p> <p></p>	<p>REPLACE speedometer head. CHECK speedometer for operation.</p> <p>GO to 3.4.</p>
<b>3.4</b>	<b>CHECK GEARS</b>		
	<ul style="list-style-type: none"> <li>• Check cable drive tip at transmission for wear.</li> </ul>	<p>Drive gear, drive tip, or driven gear damaged</p> <p>Drive gear, driven gear, and drive tip okay</p>	<p>REPLACE damaged or worn gear or cable. CHECK speedometer for operation.</p> <p>GO to 3.5.</p>
<b>3.5</b>	<b>CHECK CABLE</b>		
	<ul style="list-style-type: none"> <li>• Check speedometer cable for kinks or improper routing.</li> </ul>	<p></p> <p></p>	<p>REPLACE cable. CHECK speedometer for operation.</p> <p>GO to 3.6.</p>

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**SPEEDOMETER IS INOPERATIVE (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
3.6	CHECK SPEED SENSOR		
	<ul style="list-style-type: none"> <li>Disconnect cable from speed sensor and check that shaft in sensor turns freely</li> </ul>		REPLACE speed sensor. CHECK speedometer for operation.
			GO to 3.7.
3.7	CHECK CORE		
	<ul style="list-style-type: none"> <li>With cable disconnected, check core.</li> </ul>	Core is damaged	REPLACE core. CHECK speedometer for operation.
		Core will not turn	REPLACE cable. CHECK speedometer for operation.

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**SPEEDOMETER IS INACCURATE**

TEST STEP		RESULT	ACTION TO TAKE
4.0	DURING CHECK-OUT SPEEDOMETER REGISTERS AN INACCURATE READING		
4.1	CHECK CONNECTIONS		
	<ul style="list-style-type: none"> <li>Verify quick connect is properly attached at speedometer head.</li> </ul>	All connections are good	GO to 4.2.
		One or more of the connections are bad	REPAIR or REPLACE as necessary. CHECK for accuracy.
4.2	CHECK ODOMETER		
	<ul style="list-style-type: none"> <li>Check accuracy of odometer.</li> </ul>	Odometer is accurate	REPLACE speedometer head. CHECK for speedometer accuracy.
		Odometer is inaccurate	GO to 4.3.
4.3	CHECK DRIVEN GEAR		
	<ul style="list-style-type: none"> <li>Check for proper driven gear.</li> </ul>	Driven gear improper	REPLACE gear with correct gear. CHECK for accuracy.
		Proper driven gear	GO to 4.4.
4.4	CHECK DRIVE GEAR AXLE, TIRES, AND CORRECTOR		
	<ul style="list-style-type: none"> <li>Check for proper drive gear, axle, tires and corrector.</li> </ul>	Drive gear, axle, tires and corrector	REPLACE speedometer head. CHECK for accuracy.
		Drive gear, axle, tires or corrector are not correct	REPLACE incorrect component or driven gear. CHECK for accuracy.

CK5323-2C

cable by pulling it out of the speed sensor. Do not attempt to remove the spring retainer clip with the speedometer cable in the sensor. To install the speedometer cable, align the core with the sensor and snap cable assembly into the speed sensor.

### Installation

1. Select proper cable for vehicle, engine, and transmission as identified in the Truck Chassis Installation Manual.
2. Route cable through floorpan opening.
3. Connect speedometer cable to speedometer head (Fig. 4).
4. Attach cable clip to steering column bracket.
5. Press grommet into floorpan opening.
6. Raise vehicle on hoist.
7. Lubricate cable core exposed at transmission ferrule with Speedometer Cable Lubricant D2AZ-19581-A (ESF-M1C160-A) or equivalent.
8. Apply a coating of Ford Polyethylene Grease D0AZ-19584-A (ESB-M1C93-A) or equivalent to O-ring on ferrule.
9. Lubricate ID and teeth of driven gear with Speedometer Cable Lubricant D2AZ-19581-A or equivalent, and install driven gear on ferrule.
10. Assemble driven gear retainer to driven gear with retainer tabs toward gear teeth (Figs. 1 and 2).
11. Insert driven gear into transmission. Retain by tightening retaining screw to 2.25-2.82 N·m (20-25 in-lb).
12. Secure cable with clips/clamps at locations indicated by tape on cable.
13. Lower vehicle.

NOTE: The speedometer cable routing should avoid sharp bends; the cable should be straight for approximately 203mm (8 inches) from speedometer.

### Speedometer Core—17262

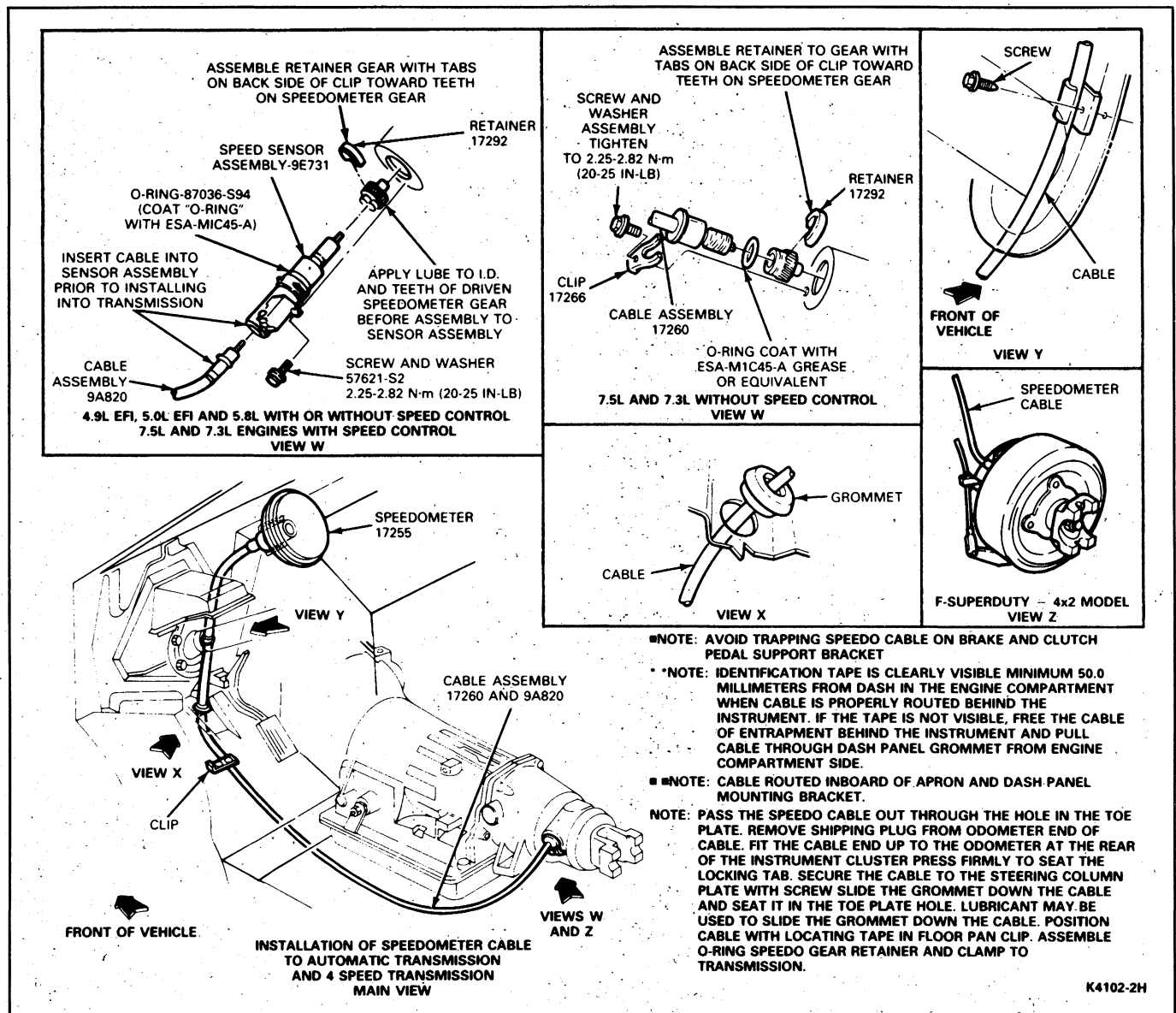
Refer to Figs. 1, 2 and 3.

### Removal

1. Disconnect speedometer cable (core and casing assembly) from speedometer head.
2. Pull speedometer core out of upper end of casing.
3. If core is broken, raise vehicle on a hoist and remove screw retaining speedometer cable clamp to transmission.
4. Remove conduit and ferrule assembly and driven gear from transmission. Remove driven gear retainer, and remove driven gear and shaft from cable.
5. Remove lower part of core (if it is broken) from lower end of casing.

### Installation

1. Position driven gear to casing and install gear retainer. Install driven gear and casing in transmission, and install retaining screw. Lower vehicle.
2. Using Motorcraft Core Repair Kit or equivalent, determine exact length of old core and cut new core so that it is 20.6mm (13/16 inch) shorter than old core. (Do not cut from squared end of core.) Remove any burrs or frayed edges.
3. Install tip on core, making certain to seat core in bottom of tip.
4. Place core and tip in a crimping die. Place die on a solid surface and strike it squarely with a hammer to crimp it.
5. Remove crimping die.
6. Lubricate core with Speedometer Cable Lubricant D2AZ-19581-A (ESF-M1C160-A) or equivalent (do not over-lubricate). Install core (square end first) into upper end of casing and push it all the way through to transmission. When cable is nearly seated, twist it slightly to make sure that square end is engaged in speedometer driven gear at transmission.
7. Connect cable assembly to speedometer, being sure to eliminate any kinks in housing and shaft. Check operation of speedometer.



**FIG. 1 Bronco, F-150—F-350 and F-Super Duty Speedometer Cable Installation (4x2)**

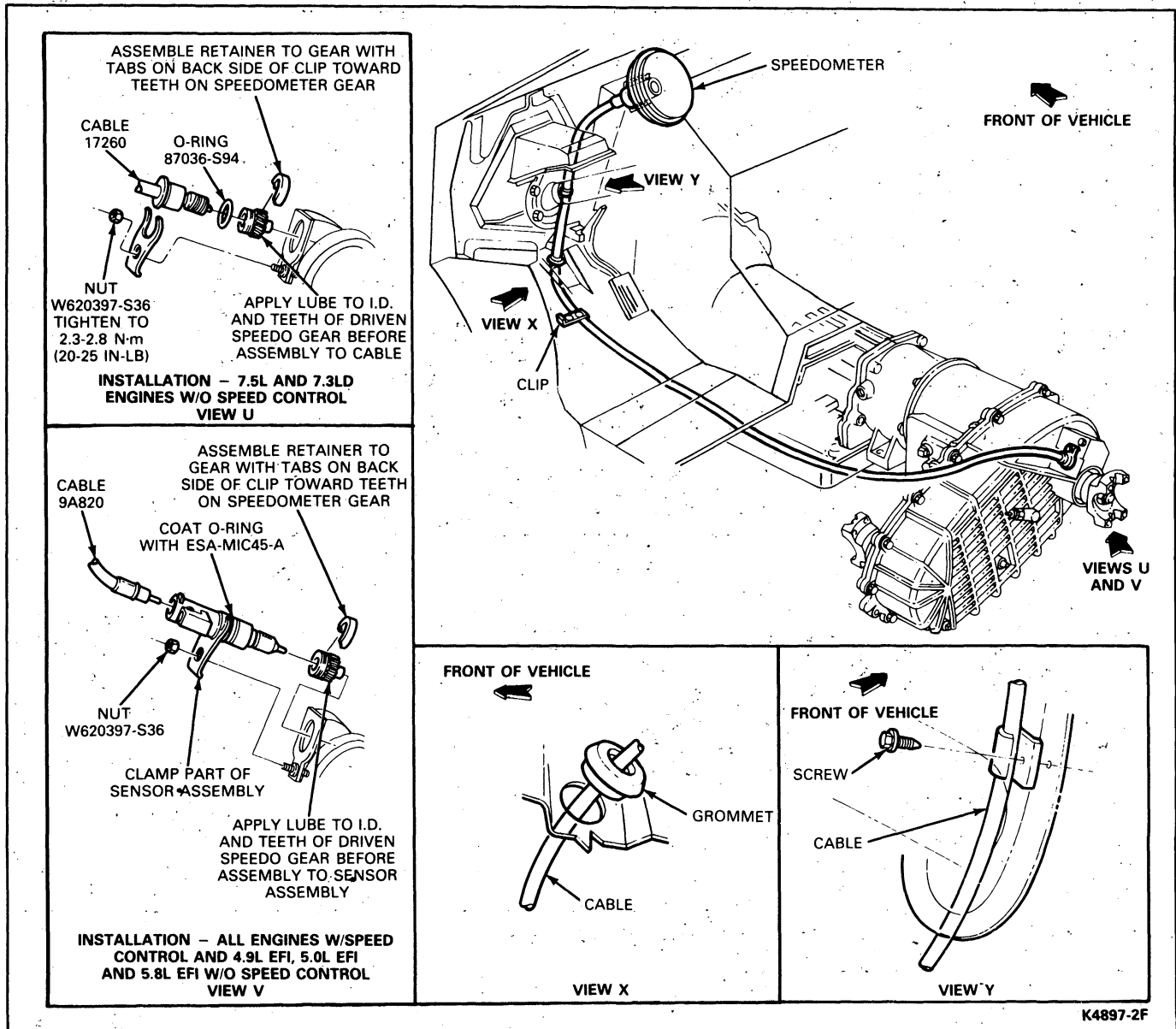


FIG. 2 F-150—F-350, F-Super Duty and Bronco Speedometer Cable Installation (4X4)



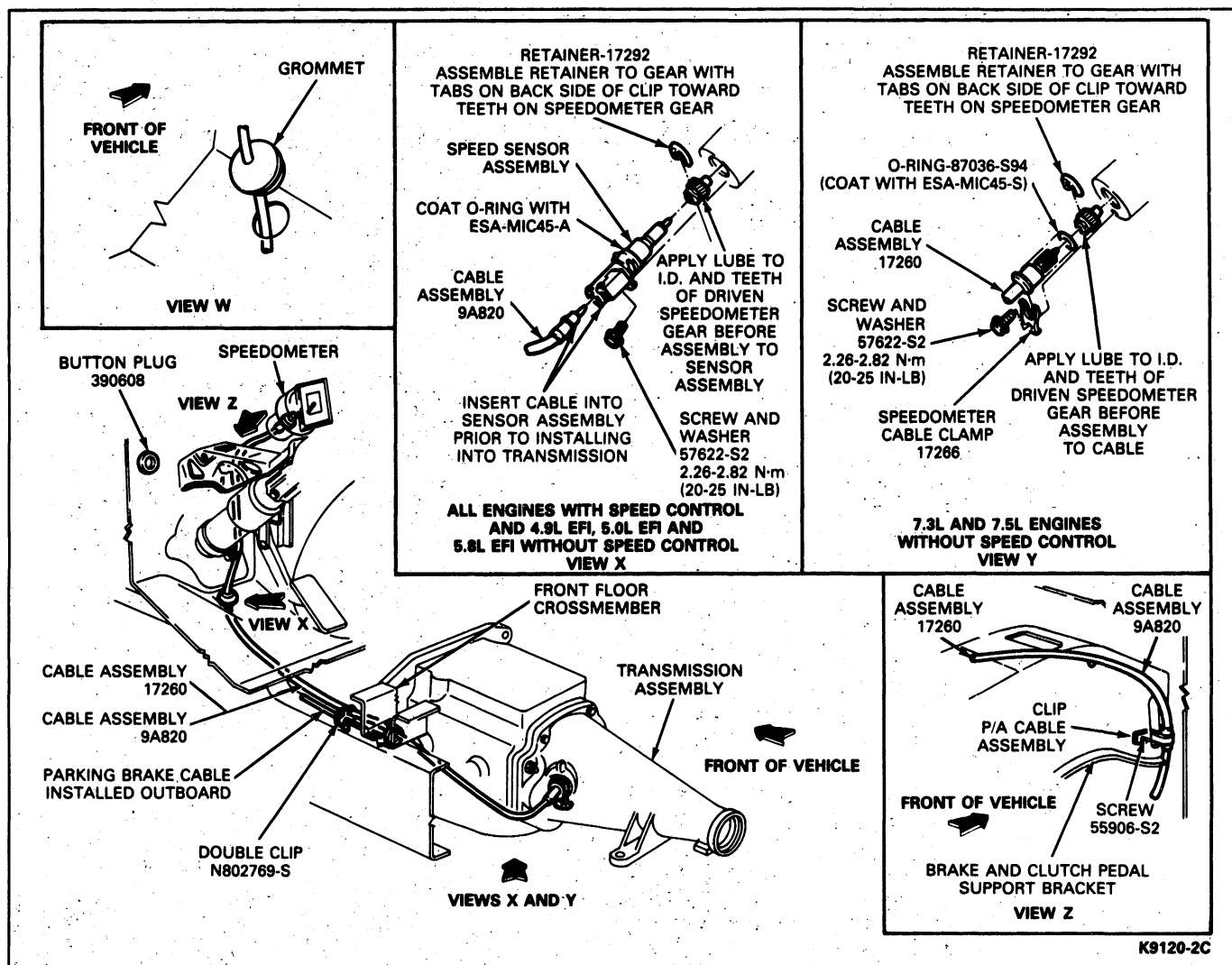


FIG. 3 E-150—E-350—Speedometer Cable Installation (Manual Trans.)

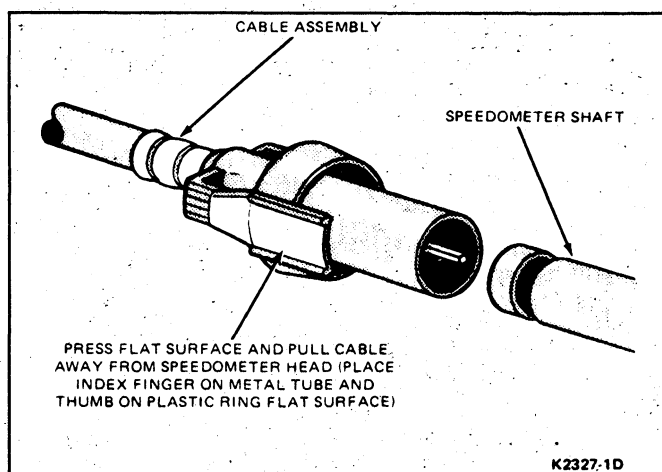


FIG. 4 Speedometer Cable Quick-Connect

## SECTION 33-04 Tachometer

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION .....	33-04-1	SPECIAL SERVICE TOOLS .....	33-04-3
DIAGNOSIS AND TESTING .....	33-04-2	VEHICLE APPLICATION .....	33-04-1
REMOVAL AND INSTALLATION .....	33-04-1		

### VEHICLE APPLICATION

F-150—F-350, F-Super Duty and Bronco.

### DESCRIPTION AND OPERATION

The tachometer is an electrically operated instrument which indicates engine speed in revolutions per minute (RPM). It is mounted in the instrument cluster assembly.

The tachometer on F-150—F-350, F-Super Duty and Bronco vehicles can be used with either 6-cylinder or 8-cylinder engines. The tachometer terminals "B" (+12 volts), "C" (coil negative), and "G" (ground) are connected when used for 6-cylinder engines. A fourth terminal "8" (8-cylinder ground) is grounded through the wire harness for 8-cylinder engine operation (Fig. 1).

**CAUTION:** The use of vinyl cleaners and other similar cleaning agents to clean the vehicle interior and/or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (O-dichlorobenzene, ethyl alcohol and/or cellosolve), has produced fogging, spotting, stain, or splotches of the lenses, either through over-spray or direct use on the lenses. Therefore, extreme caution should be taken during interior cleanup to prevent over-spray of cleaning agents which contain the chemical contents mentioned from containing the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ford Glass Cleaner D8AZ-19C507-A or

equivalent commercial cleaning product, using a clean, soft, lint-free cloth. The Ford glass cleaner has been specially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow the directions on the container for best results.

### REMOVAL AND INSTALLATION

#### Removal

1. Disconnect battery ground cable.
2. Remove instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit.
3. Remove seven screws attaching mask and lens to cluster backplate and remove mask and lens.
4. Remove tachometer by prying tachometer dial away from cluster backplate (tachometer is retained backplate by retaining clips).

#### Installation

1. Position tachometer cluster backplate, and push into position (making certain the four tachometer pins correctly seat in the cluster backplate clips).
2. Position lens and mask to the cluster backplate and install the seven attaching screws. Install the instrument cluster. Connect battery ground cable and check operation of the tachometer.

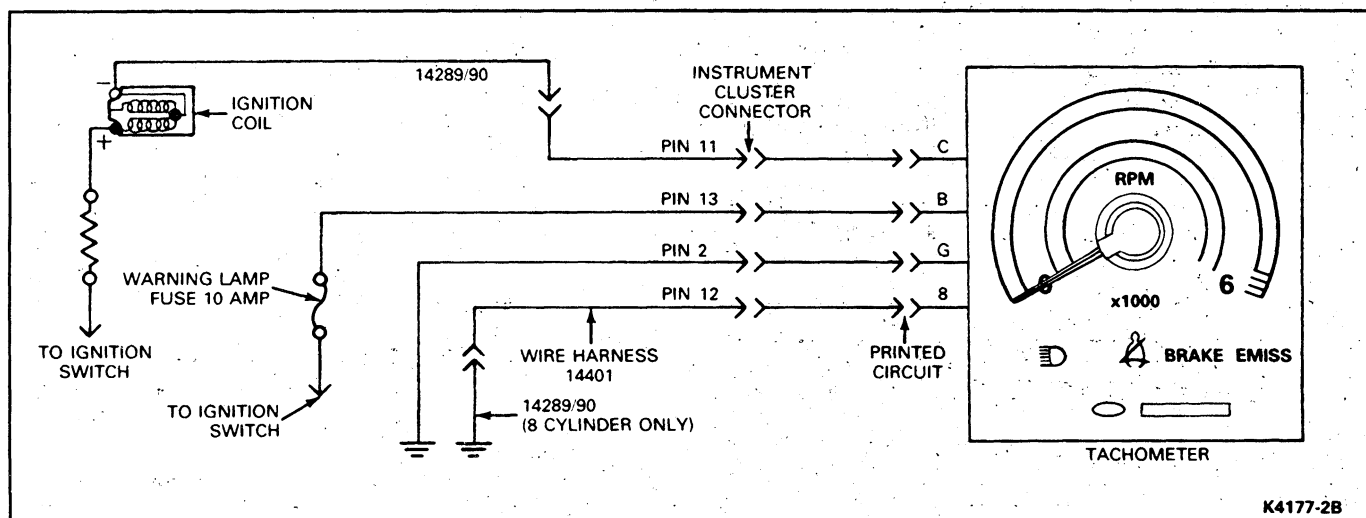










FIG. 1 Tachometer Wiring Diagram

## DIAGNOSIS AND TESTING

## INOPERATIVE, ERRATIC, WRONG INDICATION

TEST STEP		RESULT	ACTION TO TAKE
<b>A0</b>	<b>VERIFY CONDITION</b> • Check complaint.	Inoperative	GO to A1.
		Erratic and/or wrong indication	GO to A2.
<b>A1</b>	<b>CHECK FUSE</b> • Check fuse.		REPLACE fuse. If fuse blows again, CHECK for short in circuit.
			GO to A2.
<b>A2</b>	<b>CHECK WIRING</b> • Check for loose wiring connections in engine compartment or at instrument cluster.		SECURE loose connections.
			GO to A3.
<b>A3</b>	<b>MAKE RESISTANCE CHECKS</b> • Remove instrument cluster and make resistance and voltage checks (using Rotunda Digital Volt Ohmmeter 007-00001 or equivalent) at 14401 wiring harness connector as follows:  <div> </div> <ol style="list-style-type: none"> <li>1. Check pin #2 (connector 'B') resistance to chassis ground — should read 1 ohm or less.</li> <li>2. Check pin #7 (connector 'A') resistance to chassis ground — should read 1 ohm or less, if vehicle has 8-cylinder engine. Open circuit if 6-cylinder engine.</li> <li>3. Check pin #6 (connector 'A') resistance to negative terminal of ignition coil should be 1 ohm or less.</li> <li>4. Connect battery. Turn ignition switch ON. Check for +12V at pin #13 (connector 'A'). Turn ignition OFF. Disconnect battery.</li> </ol>		Condition is not in tachometer. SERVICE wiring.
			GO to A4.
<b>A4</b>	<b>CHECK TACHOMETER CONNECTIONS</b> • Check for loose or missing cluster connection clips, or damaged printed circuit.		RESEAT (or replace missing) clips and/or REPLACE printed circuit.
			REPLACE tachometer.

CK6179-2D

**SPECIAL SERVICE TOOLS****ROTUNDA EQUIPMENT**

Model	Description
007-00001	Digital Volt Ohmmeter

CK9061-1B

# SECTION 33-06 Tachometer 7.3L Diesel

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION .....	33-06-1	SPECIAL SERVICE TOOLS .....	33-06-4
DIAGNOSIS AND TESTING .....	33-06-1	VEHICLE APPLICATION .....	33-06-1
REMOVAL AND INSTALLATION .....	33-06-1		

## VEHICLE APPLICATION

F-250 through F-350 and F-Super Duty Models with 7.3L Diesel.

## DESCRIPTION AND OPERATION

The tachometer is an electrically operated instrument which indicates engine speed in revolutions per minute (rpm). It is mounted in the instrument cluster assembly.

The tachometer receives its signal from a variable reluctance sensor (mounted in the injection pump timing gear cover).

## REMOVAL AND INSTALLATION

### Removal

1. Disconnect the battery ground cable.
2. Remove the instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit.

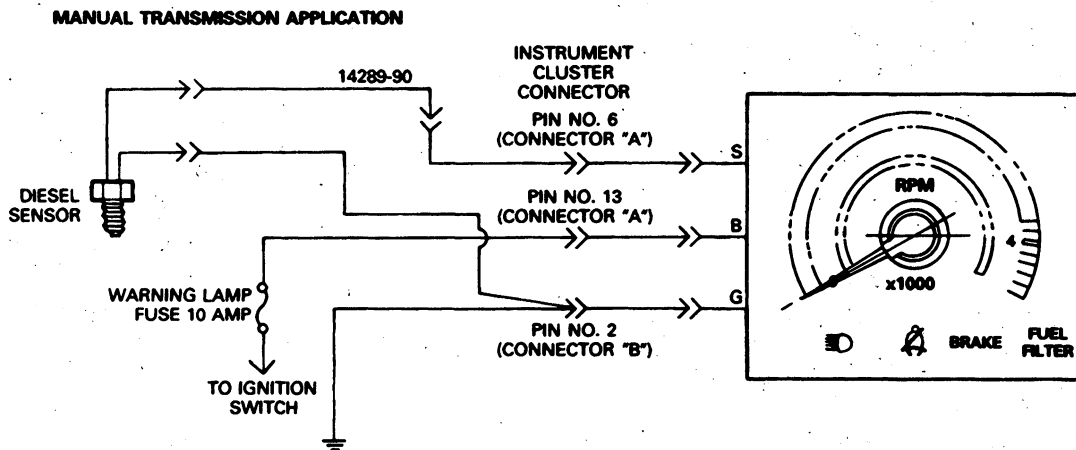
3. Remove the six screws attaching the mask and lens to the cluster backplate and remove the mask and lens.
4. Remove tachometer by prying tachometer dial away from cluster backplate (tachometer is retained to backplate by retaining clips).

### Installation

1. Position the tachometer to the cluster backplate and push the tachometer assembly into the cluster backplate.
2. Position the lens and mask to the cluster backplate and install the seven attaching screws. Install the instrument cluster. Connect the battery ground cable and check the operation of the tachometer.

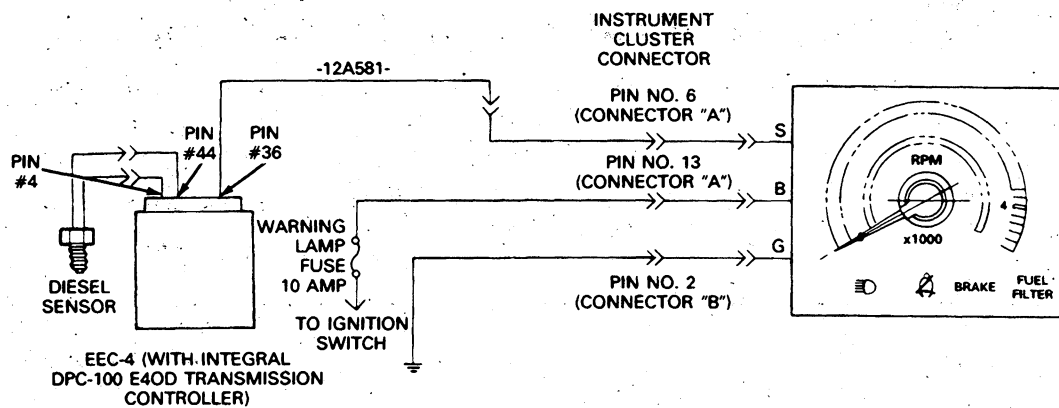
## DIAGNOSIS AND TESTING

Refer to the following schematic and Diagnosis Guides to locate and correct typical tachometer problems. Readings can be taken using Rotunda Digital Volt Ohmmeter 007-00001 or equivalent.



K12707-2B

## AUTOMATIC (E4OD) TRANSMISSION APPLICATIONS



K13847-2A

## INOPERATIVE, ERRATIC, WRONG INDICATION

TEST STEP		RESULT	ACTION TO TAKE
<b>A0</b>	<b>VERIFY CONDITION</b>		
	<ul style="list-style-type: none"> <li>Check complaint.</li> </ul>	Inoperative Erratic and/or wrong indication	GO to A1. GO to A2.
<b>A1</b>	<b>CHECK FUSE</b>		
	<ul style="list-style-type: none"> <li>Check fuse.</li> </ul>	Fuse blown Fuse is good	REPLACE fuse. If fuse blows again, CHECK for short in circuit. GO to A2.
<b>A2</b>	<b>CHECK WIRING</b>		
	<ul style="list-style-type: none"> <li>Check for loose wiring connections in engine compartment or at instrument cluster.</li> </ul>	Loose connections Connections secure	SECURE loose connections. GO to A3.
<b>A3</b>	<b>MAKE RESISTANCE CHECKS</b>		
	<ul style="list-style-type: none"> <li>Remove instrument cluster and make resistance and voltage checks at 14401 wiring harness connector as follows:</li> </ul> <div> <p>CONNECTOR "A" (LH SIDE — AS SEEN FROM REAR OF CLUSTER)</p> <p>CONNECTOR "B" (RH SIDE — AS SEEN FROM REAR OF CLUSTER)</p> </div> <ol style="list-style-type: none"> <li>Check pin No. 2 (of connector "B") resistance to chassis ground — should read 1 ohm or less.</li> <li>Check pin No. 6 (of connector "A") resistance to corresponding terminal of diesel sensor mating connector — should be 1 ohm or less.</li> <li>Connect battery. Turn ignition to the RUN position. Check for +12 volts at pin No. 13 (of connector "A"). Turn ignition OFF. Disconnect battery.</li> </ol>	Open or shorted Wiring OK	Condition is not in tachometer. SERVICE wiring. GO to A4.

CK12705-2B

TEST STEP		RESULT	ACTION TO TAKE
<b>A4</b>	<b>CHECK RETENTION CLIPS</b>		
<ul style="list-style-type: none"> <li>Check for loose tachometer retention clips on rear of instrument cluster, or damaged printed circuit.</li> </ul>		Clips loose	TIGHTEN clips and/or REPLACE printed circuit.
		Clips tight	GO to A5.
<b>A5</b>	<b>CHECK DIESEL SENSOR MOUNTING AND/OR CONNECTOR</b>		
<ul style="list-style-type: none"> <li>Check to see that sensor is not loose in its mounting (in injection pump timing gear cover). Check for loose connection.</li> </ul>		Sensor and/or connector loose	TIGHTEN sensor to 20-27 N·m (15-20 ft-lb) and/or connector.
		Sensor and connector tight	GO to A6.
<b>A6</b>	<b>CHECK DIESEL SENSOR FOR DAMAGE</b>		
<ul style="list-style-type: none"> <li>Remove sensor and check for physical damage to sensor face (resulting from contact with timing gear).</li> </ul> <p><b>NOTE: Checking continuity across the terminals of the diesel sensor will show infinite resistance.</b></p>		Sensor damaged	REPLACE sensor.
		Sensor not damaged	GO to A7.
<b>A7</b>	<b>CHECK DIESEL SENSOR RESISTANCE</b>		
<ul style="list-style-type: none"> <li>Remove sensor and check D.C. resistance across sensor terminals (with sensor in free air — no ferrous materials in its immediate vicinity). Resistance should be 2000-3000 ohms.</li> </ul>		Sensor resistance outside of specification	REPLACE sensor.
		Sensor resistance OK.	GO to A8.
<b>A8</b>	<b>E4OD AUTOMATIC TRANSMISSION APPLICATIONS ONLY DPC-100 TRANSMISSION CONTROLLER SIGNAL CHECK</b>		
<ol style="list-style-type: none"> <li>Reconnect battery cable and start engine, and allow engine to idle.</li> <li>Check RMS AC voltage of DPC-100 controller output signal (pin 6 of connector "A", at instrument cluster). Voltage value should be at least 300 mV.</li> </ol>		No signal output	REPLACE EEC-4 Processor Unit.
		Signal OK	REPLACE tachometer.

CK12706-2B

## SPECIAL SERVICE TOOLS

Number	Description
007-00001	Digital Volt Ohmmeter

CK12708-1A



# SECTION 33-10 Charge Indicator—Lamp

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION	
Charge Indicator Lamp System	33-10-1	Indicator Lamp	33-10-2
F-150—F-350, F-Super-Duty and		F-150—F-350, F-Super Duty and	
Bronco	33-10-1	Bronco	33-10-2
DIAGNOSIS AND TESTING	33-10-2	VEHICLE APPLICATION	33-10-1

## VEHICLE APPLICATION

F-150—F-350, F-Super Duty and Bronco.

## DESCRIPTION AND OPERATION

### Charge Indicator Lamp System

#### F-150—F-350, F-Super-Duty and Bronco

The battery, alternator, and electronic voltage regulator make up the charging system (Figs. 1 and 2).

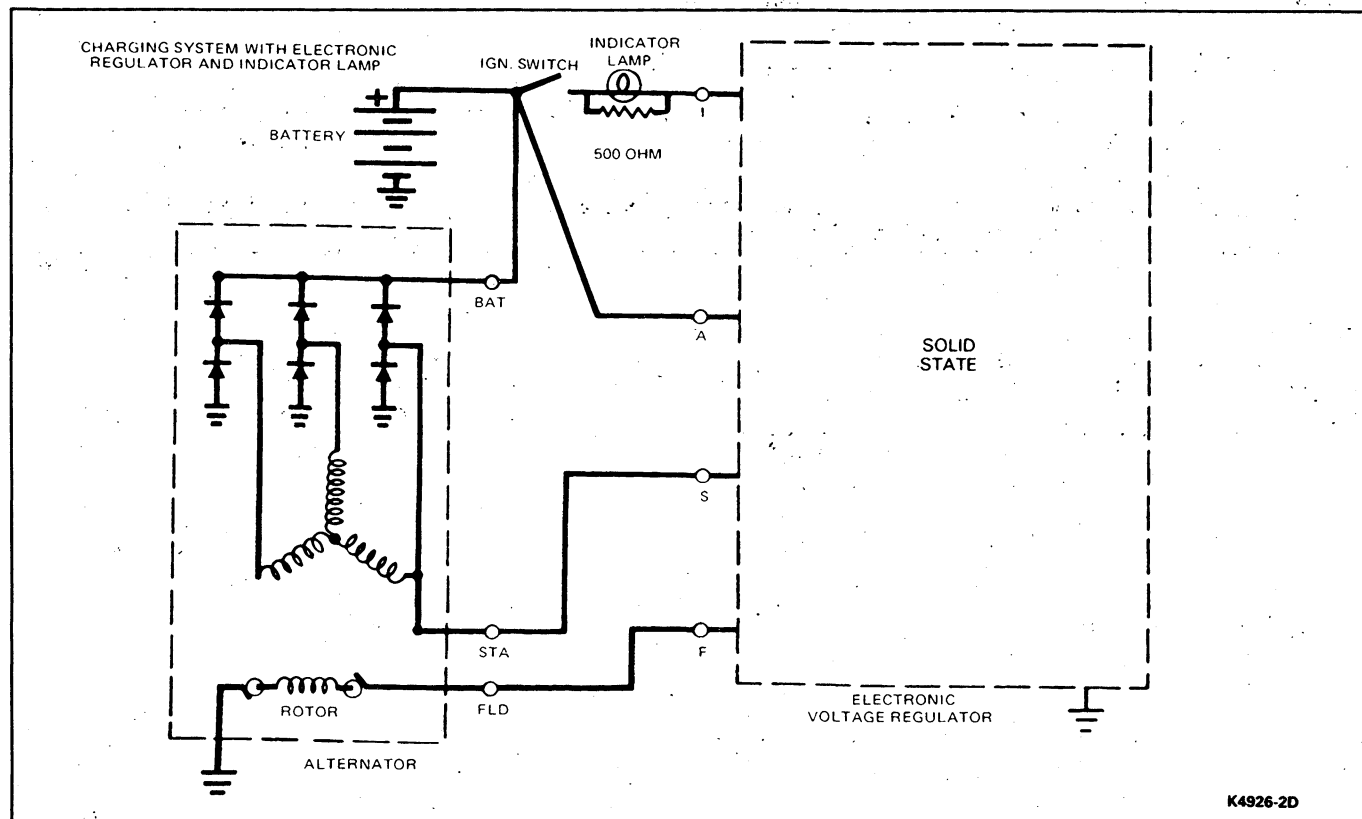
With the ignition switch in START or RUN, battery current flows through the alternator indicator lamp which is a resistor/bulb in parallel mounted in the cluster, into the regulator at terminal I, and to ground through the solid-state indicator switch. The electronic control measures a low voltage at regulator terminal A, and closes the field switch when the voltage at A is low, and opens the switch when the voltage at A is high.

With current in the field and the rotor turning, the alternator stator produces a DC voltage at terminal BAT (to battery) and terminal STA. (Voltage at STA is one-half voltage at BAT.)

A preset voltage at terminal S operates the electronic control to open the indicator switch, which removes ground from the alternator warning indicator.

The alternator output is controlled by the current in the field. The average voltage on the field depends on the percentage of time the field switch is closed. The electronic control closes the field switch when the voltage at A is low, and opens the switch when the voltage at A is high.

The voltage regulator holds the system voltage at approximately 14 volts, which may vary with temperature. The average alternator output is then any required value between zero and full current, depending on conditions sensed by the voltage regulator.



K4926-2D

FIG. 1 Charging System Schematic—EVR System

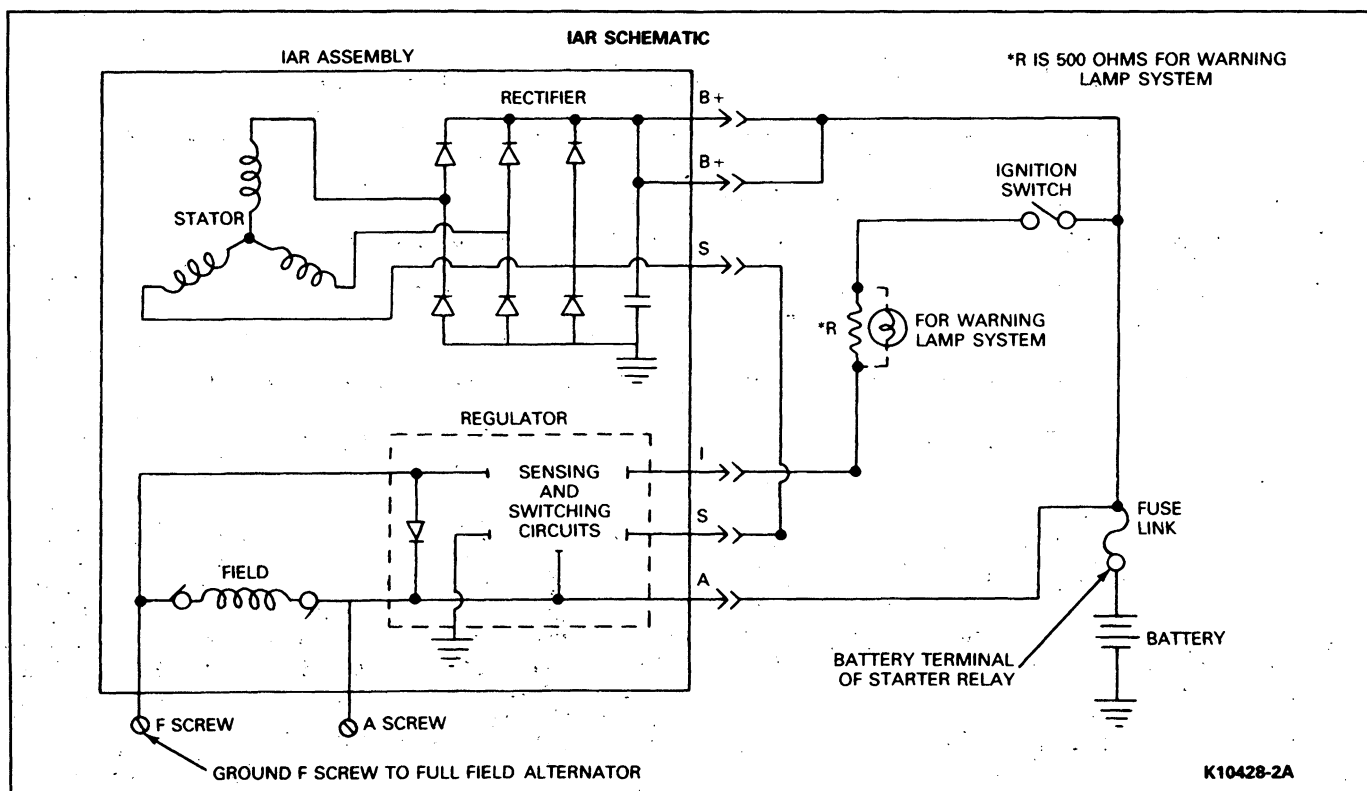


FIG. 2 Charging System Schematic—IAR System

## DIAGNOSIS AND TESTING

Refer to Section 31-01, Charging System General Service.

## REMOVAL AND INSTALLATION

### Indicator Lamp

#### F-150—F-350, F-Super Duty and Bronco

To remove the indicator bulb socket remove the instrument cluster assembly to gain access to indicator bulb socket. Refer to Section 33-51, Instrument Cluster and Printed Circuit. Turn the bulb and socket assembly one-quarter turn counterclockwise and remove. To install reverse this procedure.

**CAUTION:** The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/or instrument cluster lenses has resulted in

damage to the instrument cluster lenses. The chemical content of these cleaning agents (O-dichlorobenzene, ethyl alcohol and/or cellosolve), has produced fogging, spotting, stain, or splotches of the lenses, either through over-spray or direct use on the lenses. Therefore, extreme caution should be taken during interior cleanup to prevent over-spray of cleaning agents which contain the chemical contents mentioned from contacting the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ford Glass Cleaner E4AZ-19C507-A (ESR-M14P5-A) or equivalent commercial cleaning product, using a clean, soft, lint-free cloth. The Ford Glass Cleaner has been especially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow the directions shown on the container for best results.

# SECTION 33-12 Charge Indicator—Ammeter

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION .....	33-12-1	VEHICLE APPLICATION .....	33-12-1
DIAGNOSIS AND TESTING .....	33-12-1		
REMOVAL AND INSTALLATION			
E-150—E-350 .....	33-12-2		

## VEHICLE APPLICATION

E-150—E-350.

## DESCRIPTION AND OPERATION

The ammeter is a gauge which senses the direction and rate of flow of electrical current to or from the battery to indicate whether the battery is being charged or discharged. A shunt-type ammeter is used in E-150—E-350 (Figs. 1 and 2).

## DIAGNOSIS AND TESTING

To test the ammeter, turn the headlamps on with engine stopped. The meter pointer should move toward the D or discharge scale. If no movement of the needle is observed, check the battery to circuit breaker wire connections. If the connections are tight, and the meter does not indicate either a charge or a discharge, the meter is inoperative. Check continuity of wires. If OK, replace meter.

**CAUTION: Do not use jumper wires to detect or check operation at charge indicator subsystem.**

If the meter pointer moves toward the C or charge scale when the headlamps are turned on, the wire connections at the meter are reversed. Connect the

wires to the ammeter correctly after checking first to make sure that the battery is not reversed.

## REMOVAL AND INSTALLATION

**CAUTION: The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (O-dichlorobenzene, ethyl alcohol and/or cellosolve), has produced fogging, spotting, stain, or splotches of the lenses, either through over-spray or direct use on the lenses. Therefore, extreme caution should be taken during interior cleanup to prevent over-spray of cleaning agents which contain the chemical contents mentioned from contacting the instrument cluster lenses.**

The instrument cluster lenses should be cleaned with Ford Glass Cleaner E4AZ-19C507-A (ESR-M14P5-A) or equivalent commercial cleaning product, using a clean, soft, lint-free cloth. The Ford Glass Cleaner has been especially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow the directions on the container for best results.

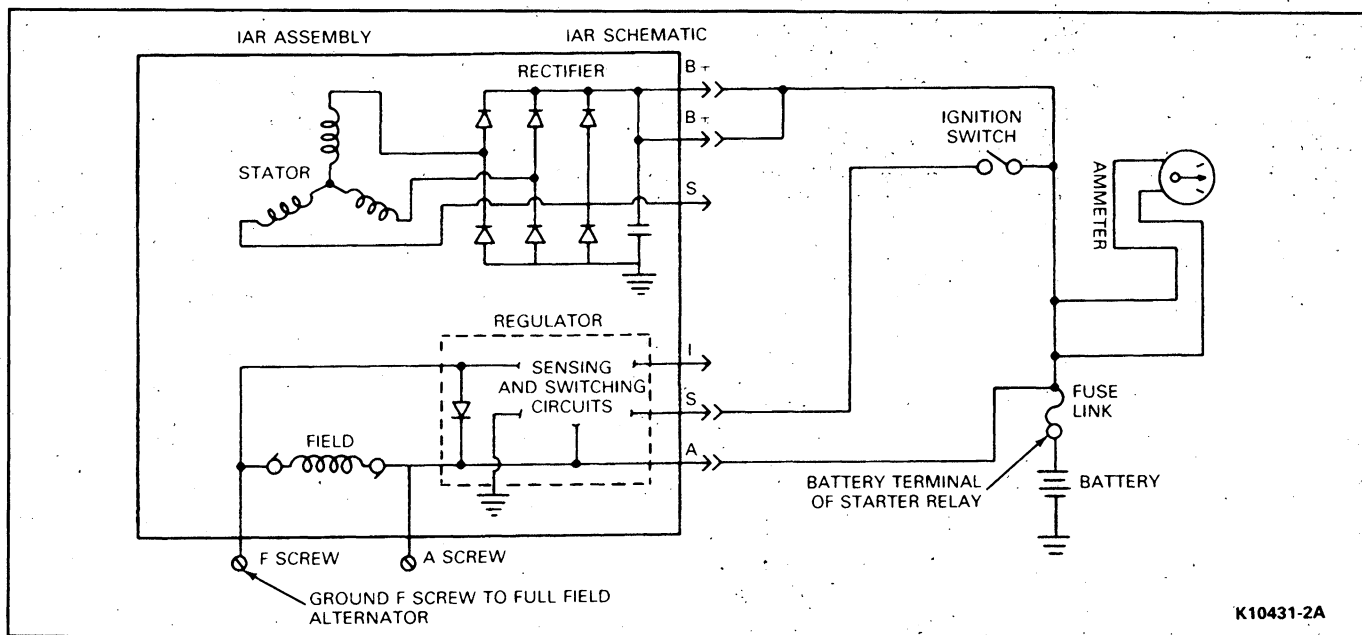
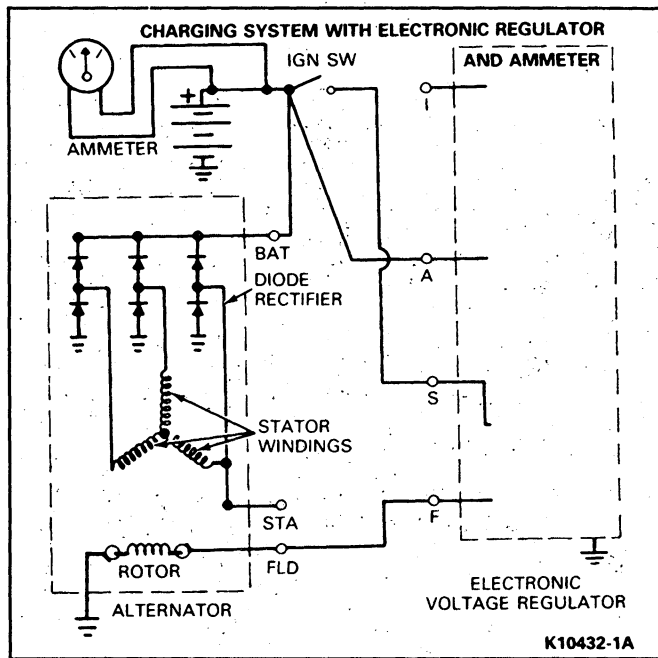


FIG. 1 IAR Ammeter System



### FIG. 2 EVR Ammeter System

**E-150—E-350**

## Removal

1. Disconnect battery ground cable.
2. Remove instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit.
3. Remove housing, lens and mask from front of cluster by removing six retaining screws.
4. Remove two retaining nuts.
5. Remove ammeter from backplate assembly.

## Installation

1. Position ammeter to backplate assembly and install two retaining nuts.
2. Insert the plastic insulator over the gauge terminals, if so equipped.
3. Install mask, lens and housing with six retaining screws.
4. Install the instrument cluster to instrument panel. Refer to Section 33-51, Instrument Cluster and Printed Circuit.
5. Connect battery ground cable. Check operation of the gauge.

# SECTION 33-15 Shift Indicator Lamp

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		REMOVAL AND INSTALLATION (Cont'd)	
Top Gear Switch .....	33-15-1	Top Gear Switch .....	33-15-1
DIAGNOSIS AND TESTING .....	33-15-1	VEHICLE APPLICATION .....	33-15-1
REMOVAL AND INSTALLATION			
Shift Indicator Lamp .....	33-15-1		

## VEHICLE APPLICATION

4.9L (300 CID) Engine with Manual Transmission.

## DESCRIPTION

The shift indicator lamp system (Fig. 1) is intended to provide the driver with optimum fuel economy and is controlled by engine speed and manifold vacuum levels. When the engine speed is greater than 900 RPM and engine vacuum is greater than 16.9 kPa (5 in.-Hg.) in part throttle range, the shift indicator lamp comes on, indicating the proper time to upshift. There is a slight delay (approximately 1 second) in the lamp coming on after these conditions are met. The lamp itself is located in the far LH "eyebrow" of the instrument panel on EEC-IV vehicles.

On EEC-IV vehicles, the system is incorporated into the EEC module. There is a top gear switch (mechanical linkage) which prevents the lamp from lighting in top gear. There is also a dimmer relay which reduces the brightness of the lamp when the headlights are turned on.

## Top Gear Switch

The top gear switch is located at the top, RH side of the transmission case. This switch and temperature inhibitors (some are switches and some are purely mechanical devices—depending on the calibration) merely prevent the shift indicator lamp from lighting up when the vehicle is in the top gear.

## DIAGNOSIS AND TESTING

For Diagnosis and Testing procedures, refer to Section 17 of the Engine/Emissions Diagnosis manual.\*

## REMOVAL AND INSTALLATION

### Shift Indicator Lamp

#### Removal

1. Disconnect battery ground cable.
2. Remove instrument panel trim panel.
3. Remove instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit.
4. Remove bulb from shift indicator assembly.

#### Installation

1. Install bulb into shift indicator assembly.
2. Install instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit.
3. Install instrument panel trim panel.
4. Connect battery ground cable. Test system for correct operation of lamp.

### Top Gear Switch

#### Removal

1. Disconnect battery ground cable.
2. Disconnect electrical connection (pull straight out).
3. Remove bolt from the switch and remove switch.

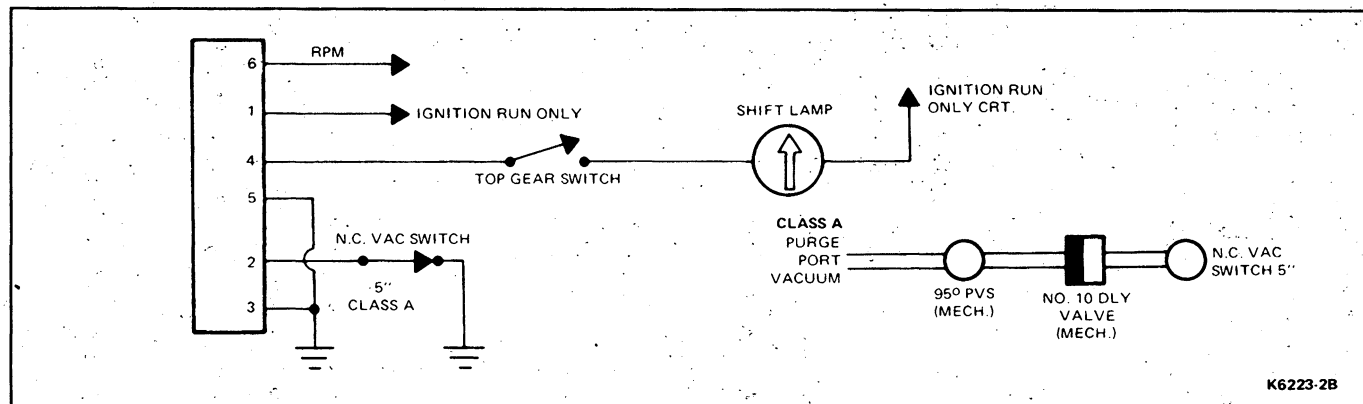


FIG. 1 Shift Indicator Lamp—Wiring Schematic

\*Can be purchased as a separate item.

**Installation**

1. Install switch and secure with attaching bolt.
2. Connect electrical connector.
3. Connect battery ground cable. Test system for correct operation.

# SECTION 33-20 Fuel Indicating System

SUBJECT	PAGE	SUBJECT	PAGE
<b>DESCRIPTION AND OPERATION</b>		<b>DIAGNOSIS AND TESTING (Cont'd)</b>	
Fuel Level Indicating System .....	33-20-1	Diagnosis Guides .....	33-20-6
All Models .....	33-20-1	Fuel Selector Valve—Dual Tanks With EFI Engines .....	33-20-4
Fuel Indicator (Gauge) .....	33-20-1	Fuel Selector Valve—Dual Tanks With Fuel Return Lines (7.3L Diesel Only) .....	33-20-5
Fuel Sender .....	33-20-1	Fuel Tank Damage .....	33-20-4
Instrument Voltage Regulator .....	33-20-1	<b>REMOVAL AND INSTALLATION</b>	
Fuel Tank Selector Switch .....	33-20-2	Fuel Gauge .....	33-20-7
<b>DIAGNOSIS AND TESTING</b>		F-150—F-350 and F-Super Duty Bronco and E-150—E-350 .....	33-20-7
All Models .....	33-20-2	Sending Units Secured With Metal Locking Ring .....	33-20-7
Calibration Check .....	33-20-2	Sending Units Secured With Plastic Locking Ring .....	33-20-7
Calibration Test (using Rotunda Tester 021-00055)—Econoline .....	33-20-2	<b>SPECIAL SERVICE TOOLS</b> .....	33-20-10
Calibration Test (Without Tester)—Econoline .....	33-20-4	<b>VEHICLE APPLICATION</b> .....	33-20-1
Functional Test .....	33-20-2		
Gauge Bench Test for Open Windings .....	33-20-4		
Test Set-Up .....	33-20-2		

## VEHICLE APPLICATION

All Models.

## DESCRIPTION AND OPERATION

### Fuel Level Indicating System

#### All Models

The fuel indicating system is a bimetal-resistance type system for Econoline and a magnetic type system for F-Series. The Econoline system consists of an instrument voltage regulator, fuel indicator (gauge) mounted in the instrument cluster and a sender located in the fuel tank (Fig. 1).

The F-Series system consists of a fuel indicator gauge mounted in the instrument cluster and a sending unit mounted in the fuel tank (Fig. 2).

#### Instrument Voltage Regulator

##### Econoline

The instrument voltage regulator (IVR) used with the bi-metal fuel indicator (gauge) controls and maintains an average pulsating voltage of 5.0 volts at the gauge terminals.

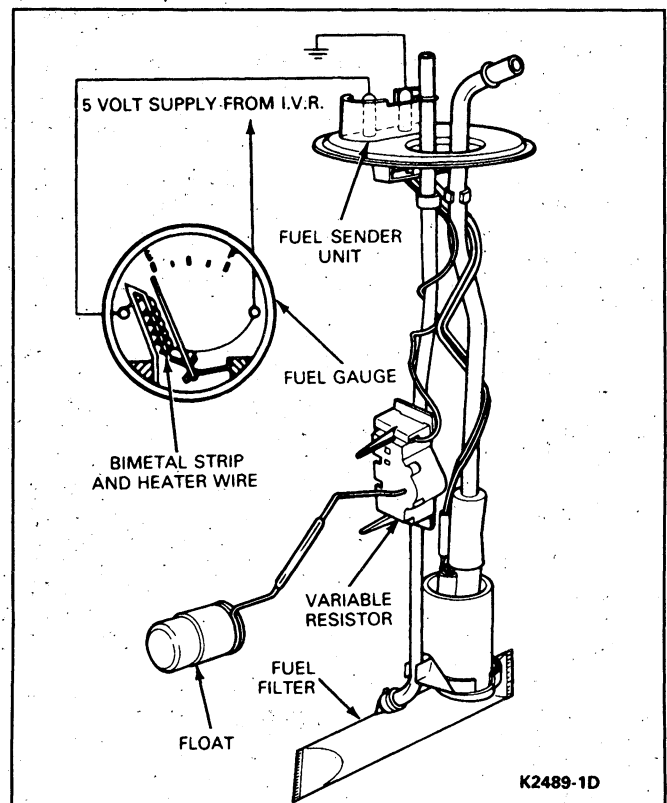
#### Fuel Indicator (Gauge)

The bi-metal (Econoline) fuel indicator gauge pointer is attached to a wire-wound bimetal strip which, when heated by the flow of electrical current controlled by the sender unit, produces the appropriate indication.

The magnetic (F-Series) fuel indicator gauge creates a polarity in the wire windings which, depending on the resistance at the sender, controls the degree of pointer rotation. The magnetic gauge operates on battery voltage (12V).

#### Fuel Sender

The fuel sender consists of a variable resistor, controlled by the action of an attached float in the fuel



**FIG. 1 Fuel Indicating System Using a Bimetal Gauge—Econoline**

tank (Figs. 1 and 2). The variable resistor consists of a screened resistive material on a ceramic substrate. The resistive characteristics of the two types of gauges are shown in Fig. 3.

The fuel sender portion of the fuel sender for the 4.9L EFI, 5.0L EFI, 5.8L EFI and the 7.5L EFI engines

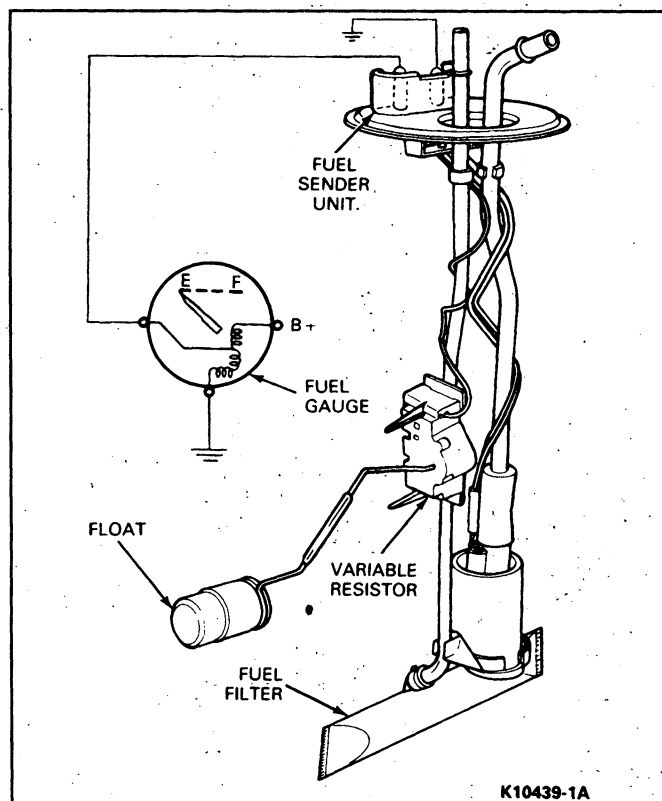


FIG. 2 Fuel Indicating System Using a Magnetic Gauge—F-150-F-350 and F-Super Duty

FUEL SENDER RESISTANCE		
Type of Gauge	Full Tank	Empty Tank
Bi-Metal	10 ohms	70 ohms
Magnetic	160 ohms	15 ohms

CK10440-1A

FIG. 3 Fuel Indicating System—Sender Resistance

operate the same as described previously. The sender has an integral fuel pump (Figs. 4 and 5), and the electrical connector has four pins, two for the sender function and two for the electrical fuel pump.

NOTE: The fuel sender used with the (F-350 and F-Super Duty) plastic aft-axle tank has only three pins, as the pump and sender share a common ground.

The fuel sender for the 7.3L diesel also operates the same as previously described, except for the following differences. The sender electrical connector has two pins instead of four as there is no electric fuel pump. The filter is replaced by an inverted flexible cone-like member. The flexible cone ensures fuel is always being taken from the bottom of the tank. The cone has as part of its assembly a relief-bypass valve (Fig. 6). If the intake becomes obstructed at low temperatures the relief valve opens, allowing fuel to bypass the filter.

The fuel senders used with all engines equipped with EFI, as well as the 7.3L diesel engine have a fuel return port which allows excess fuel delivered to the engine to be returned to the fuel tank.

### Fuel Tank Selector Switch

All fuel gage sensing on vehicles with dual tanks (except with 7.3L Diesel engine) passes through the fuel

tank selector switch. The circuit diagrams are shown in Figures 7 and 8.

## DIAGNOSIS AND TESTING

### All Models

#### Calibration Test (using Rotunda Tester 021-00055)—Econoline

The Rotunda Instrument Gauge System Tester 021-00055 or equivalent (Fig. 9), is used to diagnose problems in all fuel indicating systems using the bimetal fuel indicator gauge and instrument voltage regulator (IVR).

Prior to performing fuel system test, the following tester checks should be made.

1. Set tester switch at IVR CHECK position.
2. Attach tester ground wire to the negative (-) terminal of 12-volt battery and touch one of the tester terminals marked with an arrow to the positive (+) battery terminal.
3. If the IVR check lamp does not come on, return tester for service or replacement.

### Test Set-Up

**CAUTION:** During in-vehicle tests, do not let tester terminal studs designated by arrows come in contact with vehicle ground. The fuel gauge will be shorted to ground, preventing an accurate test and possibly damaging the IVR or gauge. Never apply vehicle voltage across sender, IVR or gauge.

1. Disconnect connector from fuel sender and hook onto the matching terminals on the tester (Fig. 9).
2. Turn vehicle ignition switch to ACC position.

### Functional Test

NOTE: The IVR also supplies a common regulated voltage for the temperature gauge indicating system and oil gauge indicating system (when applicable), therefore, the IVR can only be damaged if the other gauges exhibit similar problems (fluctuating movement or high or low indications at the upper calibration band). The IVR has little affect on the lower calibration band of the indicator.

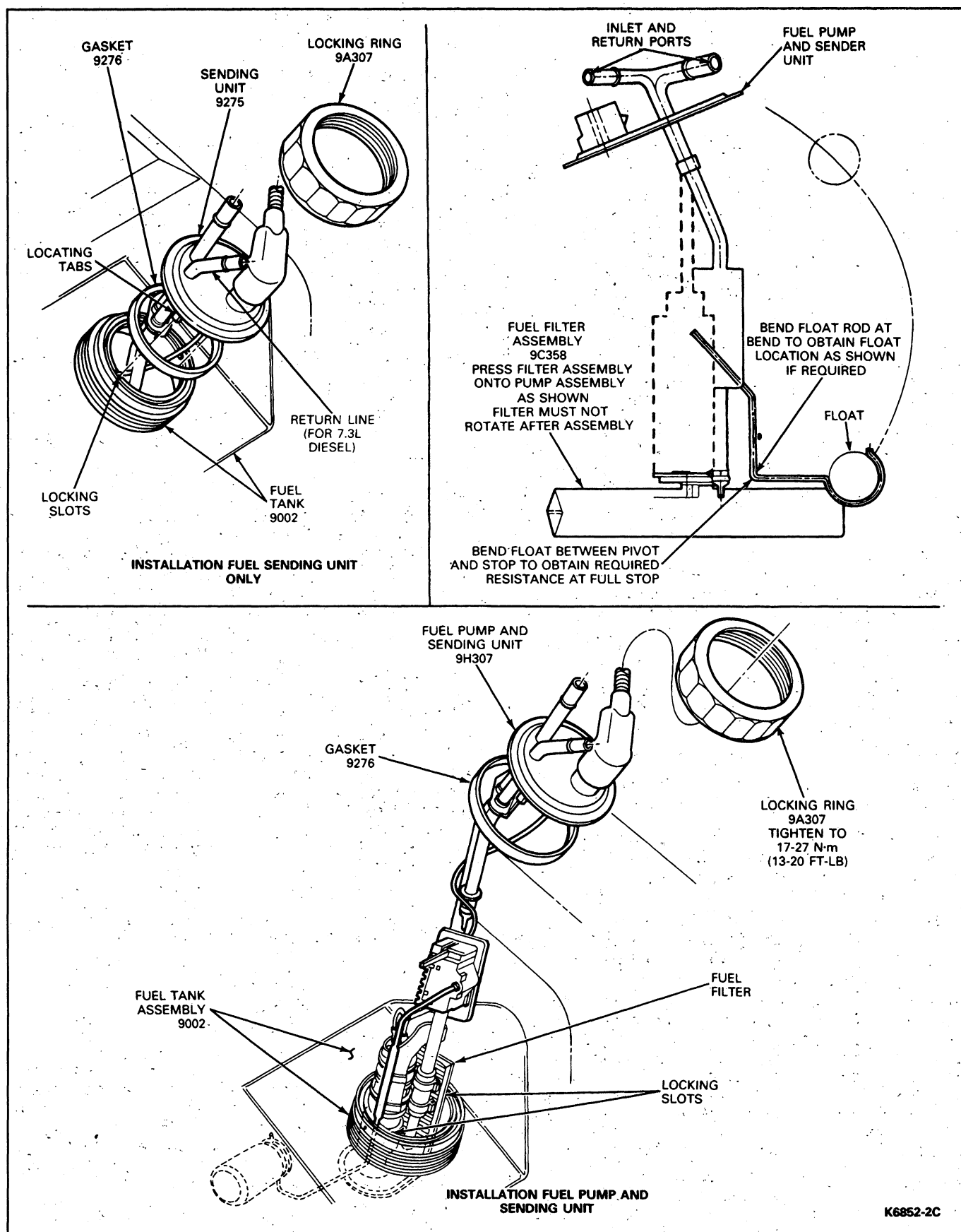
1. Set tester switch to IVR CHECK position.
2. If IVR check lamp flashes on and off, the IVR and wiring are functional. Proceed to calibration check.
3. If IVR check lamp is on steady, check IVR ground screw. If ground screw is secure, replace IVR.
4. If IVR check lamp does not come on, check for open circuit in gauge and/or circuit wiring.

NOTE: If IVR check lamp does not come on, also check plug-in connector at the instrument cluster printed circuit for proper insertion. A poor tester ground connection, when used with single terminal fuel senders, will prevent the IVR check lamp from coming on. Also check for corroded terminals on the connector at the fuel sender and on the fuel sender-unit terminals.

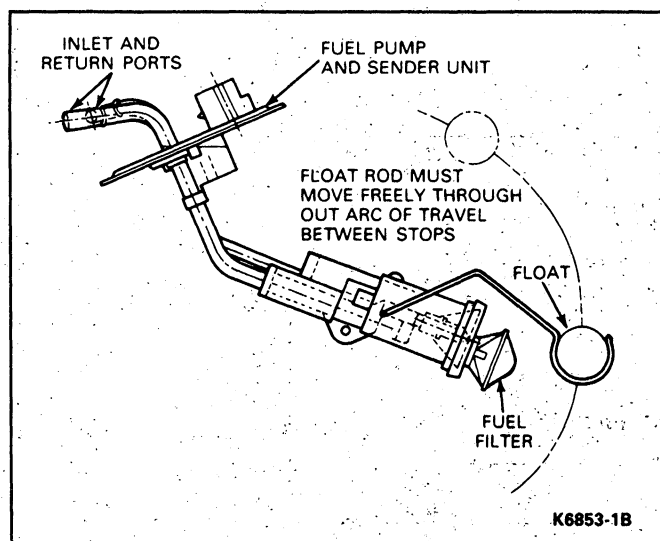
### Calibration Check

With the tester switch in either the HIGH or LOW position, the center line of the gauge pointer should be within, or the pointer edge touching, the "F" or "E" white band of the graphics for the fuel test function as shown on the tester after two minutes (Fig. 9). If the

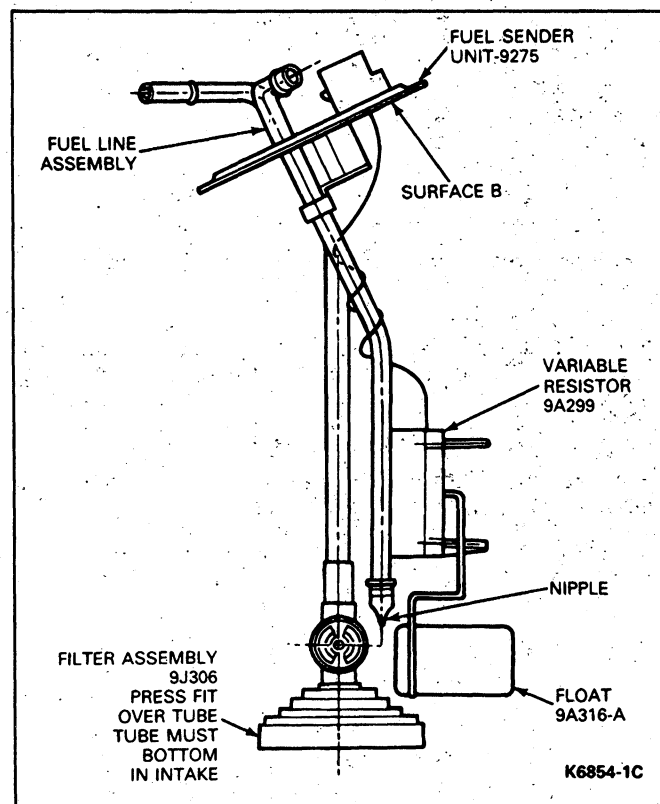




**FIG. 4 Fuel Sender With Integral Electric Fuel Pump—F-350 and F-Super Duty Chassis Cab (Plastic Tank), 4.9L, 5.8L and 7.5L EFI Engines**



**FIG. 5 Fuel Sender—All EFI Equipped Engines with Steel Fuel Tanks**



**FIG. 6 Fuel Sender—7.3L Diesel Engine**

centerline of the pointer registers in the white bands, the fuel indicating system is operating properly and replacement of the fuel sender is necessary. If the pointer center line falls outside the "E" white band, replace the fuel gauge. If the pointer center line falls outside the "F" white band, replace the IVR and retest. If still outside the "F" white band, replace the fuel gauge, install the original IVR and test for calibration.

#### **Calibration Test (Without Tester)—Econoline**

If only the fuel gauge is inoperative or appears to be out of calibration, a calibration test can be conducted on

the vehicle fuel gauge system. The calibration test checks the fuel gauge and IVR simultaneously (Fig. 10).

- Fuel gauge check without box resistance = 10 ohms and 73 ohms.
- With 10 ohms, pointer should be at or above "F" by approximately two pointer widths.
- With 73 ohms, pointer should be at or below "E" by two pointer widths.

If the gauge pointer does not move and stays below the E mark, check for an open circuit in the wiring assembly, the gauge windings, or the instrument cluster printed circuit. If the gauge pointer moves without any resistor connected, check for a short circuit in the lead to the sender unit. If the gauge reads out of calibration, replace IVR and retest. If still out of calibration, replace the gauge.

#### **Calibration Test (Without Tester)—F-150—F-350 and F-Super Duty**

If only the fuel gauge is inoperative or appears to be out of calibration, a calibration test can be conducted on the vehicle fuel gauge system.

- Fuel gauge check without box resistance = 160 ohms and 15 ohms.
- With 145 ohms, pointer should be between the two printed dots at "F" mark on gauge face.
- With 22 ohms, pointer should be between the two printed dots at "E" mark on gauge face.

#### **Fuel Indicator Second Sender Test—F-Series Dual Tanks**

On F-Series midship (standard) fuel tank, the fuel sender electrical connector can be disconnected and attached to a second test sender outside the tank. The float can then be manually operated (up and down) while the fuel gauge operation is observed. Proper gauge function indicates a problem with the fuel sender. Improper operation indicates a problem with the gauge or wiring. Refer to Diagnosis and Testing for Fuel Tank Sending Unit diagnosis.

#### **Gauge Bench Test for Open Windings**

To test the gauge for open windings, remove the gauge from the vehicle. Connect the gauge to an ohmmeter such as Rotunda Digital Volt Ohm Meter 007-00001 or equivalent, and read the resistance. Battery positive to sender resistance should be 80 to 90 ohms and sender to ground should be 190 to 200 ohms (Fig. 11). If the ohmmeter reads open or low resistance, replace the gauge.

#### **Fuel Tank Damage**

If fuel indicating system components are functioning properly and inaccurate indications continue, check the fuel tank for damage which may have changed the fuel sender mounting angle and/or damaged the fuel sender.

#### **Fuel Selector Valve—Dual Tanks With EFI Engines**

The fuel selector valve for EFI equipped vehicles is mechanically operated and uses in-tank pump pressure to control fuel supply and return. Front or rear tank indication is controlled by the selector switch.

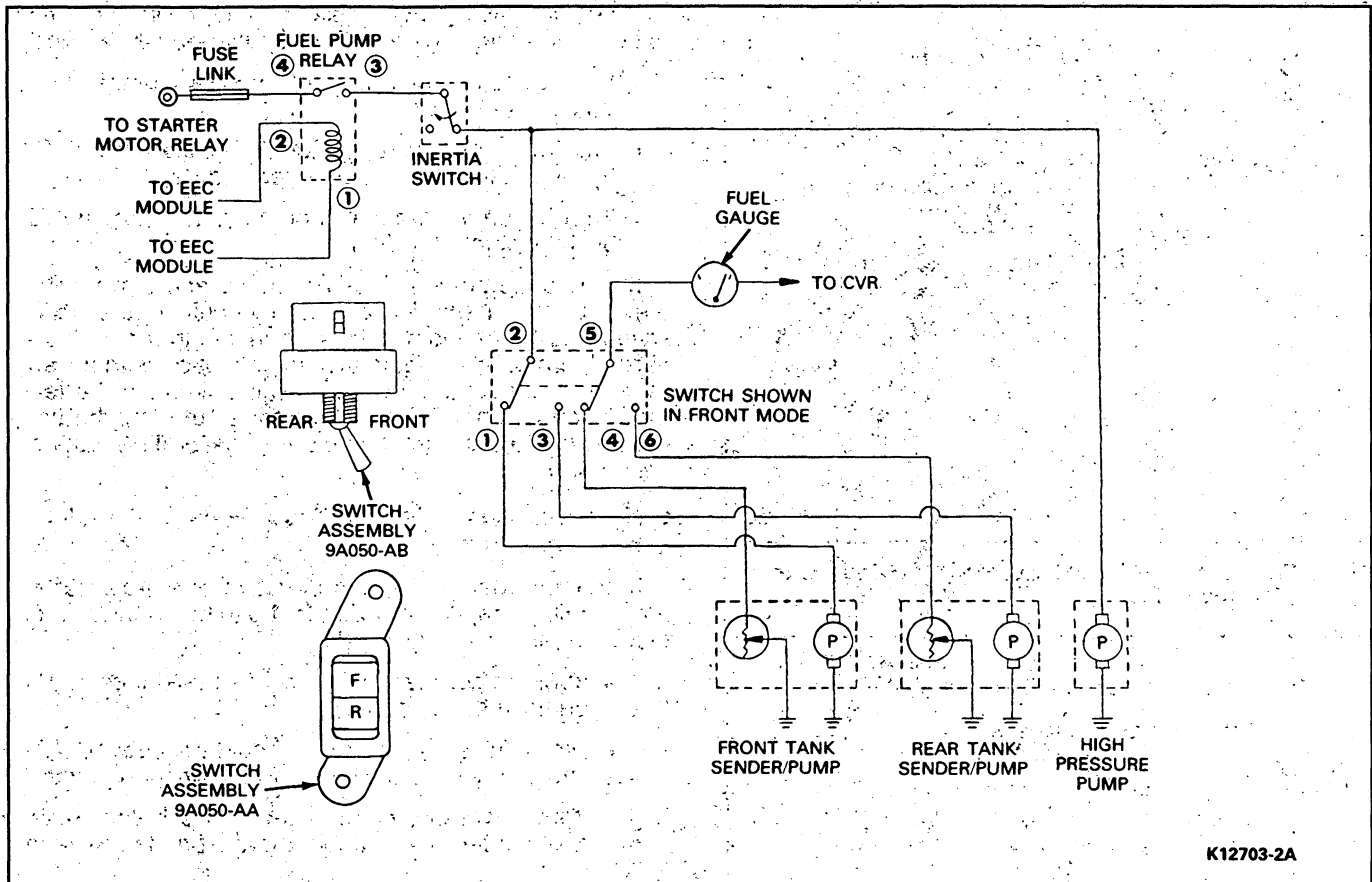


FIG. 7 Fuel Tank Selector Switch Circuit—Except 7.3L Diesel

### Fuel Selector Valve—Dual Tanks With Fuel Return Lines (7.3L Diesel only)

The following diagnosis guide is for vehicles equipped with dual tanks and fuel return lines (6-port fuel selector valve). Refer to Fig. 12 for 6-port fuel selector valve connector terminal numbers. Refer to

Figs. 13 and 14 for a view of the 6-port fuel selector valve. Make certain that both tanks contain some usable fuel.

### Fuel Tank Sending Unit-All Models

Refer to the Diagnosis Guides when diagnosing fuel tank sending unit related problems:

## Diagnosis Guides



CONDITION	POSSIBLE SOURCE	ACTION
Gauge shows full or partial tank when tank is empty.	<ol style="list-style-type: none"> <li>1. Wrong sender installed.</li> <li>2. Sender arm is bent or obstructed.</li> <li>3. Improper sender calibration.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check part number. Install correct sender.</li> <li>2. Check sender mounting angle. Bend sender arm gently to correct position.</li> <li>3. Test for correct resistance values and replace as needed.</li> </ol>
Gauge reads full at all fuel levels.	<ol style="list-style-type: none"> <li>1. Short circuit in wiring.</li> <li>2. Sender arm movement obstructed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and repair wiring and/or connectors as necessary.</li> <li>2. Check for correct part number and correct angle. Bend sender arm gently away from obstruction or remove obstruction if possible.</li> </ol>
Gauge reading fluctuates (erratic).	<ol style="list-style-type: none"> <li>1. Loose connection or damaged wiring.</li> <li>2. Loose sender resistor winding.</li> <li>3. Leaking sender float.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten all connections and terminations. Check and repair wiring for shorts or opens.</li> <li>2. Check sender for smooth electrical resistance change as arm is moved through full range. If resistance readings hesitate or jump, replace sender.</li> <li>3. Replace float.</li> </ol>

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CONDITION	POSSIBLE SOURCE	ACTION
Fuel gauge shows empty at all levels of fill.	<ol style="list-style-type: none"> <li>1. Loose or dirty wiring connections or short to ground in wiring.</li> <li>2. Leaking sender float.</li> <li>3. Missing sender float.</li> <li>4. Open circuit in sender (Econoline). Short circuit (F-Series).</li> <li>5. Sender arm movement obstructed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check wiring connectors and sender terminals. Repair, clean, or tighten as needed.</li> <li>2. Replace float.</li> <li>3. Install float. Ensure float is securely retained on sender arm.</li> <li>4. Test for correct resistance values and replace if needed.</li> <li>5. Reinstall sender properly. Bend arm to correct position if needed.</li> </ol>
Fuel gauge will not read full when tank is full.	<ol style="list-style-type: none"> <li>1. Wrong sender installed.</li> <li>2. Sender arm movement obstructed.</li> <li>3. Leaking float.</li> <li>4. Sender or gauge calibration.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check part number. Install correct part.</li> <li>2. Reinstall sender to correct operation. Bend sender arm slightly away from obstruction or remove obstruction.</li> <li>3. Install new float.</li> <li>4. Test for correct resistance valve and replace if needed.</li> </ol>

CK5822-2C

**NO FUEL LEVEL INDICATION — VEHICLES WITH DUAL TANKS (6 PORT FUEL SELECTOR VALVE)**

TEST STEP		RESULT	ACTION TO TAKE
<b>A1</b>	<b>BYPASS TANK SELECTOR VALVE</b>		
<ul style="list-style-type: none"> <li>• Disconnect electrical connector from tank selector valve.</li> <li>• Turn ignition to RUN position.</li> <li>• Jumper connector terminals No. 4 and No. 5 for rear tank.</li> <li>• Fuel gauge should indicate fuel level in rear tank.</li> <li>• Jumper connector terminals No. 3 and No. 4 for front tank.</li> <li>• Fuel gauge should indicate fuel level in front tank.</li> </ul>			REPLACE fuel tank selector valve.
			CHECK for faulty fuel gauge, fuel sender and/or wiring. REPAIR or REPLACE as necessary.

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**REMOVAL AND INSTALLATION****Sending Units Secured With Metal Locking Ring****Removal**

1. Remove the fuel from the fuel tank until fuel level is below fuel sender mounting hole.

NOTE: For sending unit removal and installation for E-Series EFI equipped (4.9L, 5.0L, 5.8L, 7.5L) engines refer to Section 24-50, Fuel Tank and Lines and Fuel Evaporative Emission Control System.

2. Disconnect the wiring connector from the fuel system sender.
3. Remove any dirt that has accumulated around the sender so that it will not enter the tank or lines.
4. Loosen the quick connect fittings and disconnect the fuel tank line at the sender.
5. Turn the fuel sender locking ring counterclockwise with Fuel Tank Sender Wrench T74P-9275-A or equivalent. Remove the locking ring, sender and sealing gasket.

**Installation**

1. Clean the fuel sender mounting surface on the fuel tank.
2. Place a new sealing gasket in the groove of the fuel tank. Install the fuel sender into the fuel tank so that the tabs of the sender are positioned into slots of the fuel tank. The sealing gasket must remain in place during and after fuel sender installation (Fig. 15, View A).
3. Holding the fuel sender and sealing gasket in place, install and rotate the locking ring clockwise until the stop is against the retainer ring tab (Fig. 15, View B).
4. Connect the fuel sender wire and the fuel tank line.
5. Refill the tank with the fuel removed. Check for proper fuel gauge operation and for leaks while refilling.

**Sending Units Secured With Plastic Locking Ring****Removal**

1. Remove fuel from the fuel tank.
2. Disconnect the wiring connector from the fuel sender.
3. Remove any dirt that has accumulated around the sending unit so that it will not enter the tank or lines.
4. Loosen the quick-connect fittings and disconnect the fuel line at the sender.
5. Turn the fuel sending locking ring counterclockwise with a band-type oil filter wrench or equivalent. Remove the locking ring fuel sender and sealing gasket (Fig. 16).

**Installation**

1. Clean the fuel gauge sending unit mounting surface at the fuel tank.
2. Place a new sealing gasket in the groove of the fuel tank. Install the fuel sender into the fuel tank so that the tabs of the sender are positioned into the fuel tank slots. The sealing gasket must remain in place during and after fuel sender installation (Fig. 16).
3. Holding the fuel sender and sealing gasket in place, install and rotate the plastic locking ring clockwise until handtight. Using the service wrench, tighten locking ring to 18-27 N·m (13-20 ft-lb).
4. Connect the wire and the fuel line.
5. Refill the tank with the fuel removed. Check for leaks and proper fuel gauge operation while refilling.

**Fuel Gauge**

**F-150—F-350 and F-Super Duty Bronco and E-150—E-350.**

**Removal**

1. Disconnect battery ground cable.
2. Remove this instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit.
3. Remove the lens and mask from the cluster.

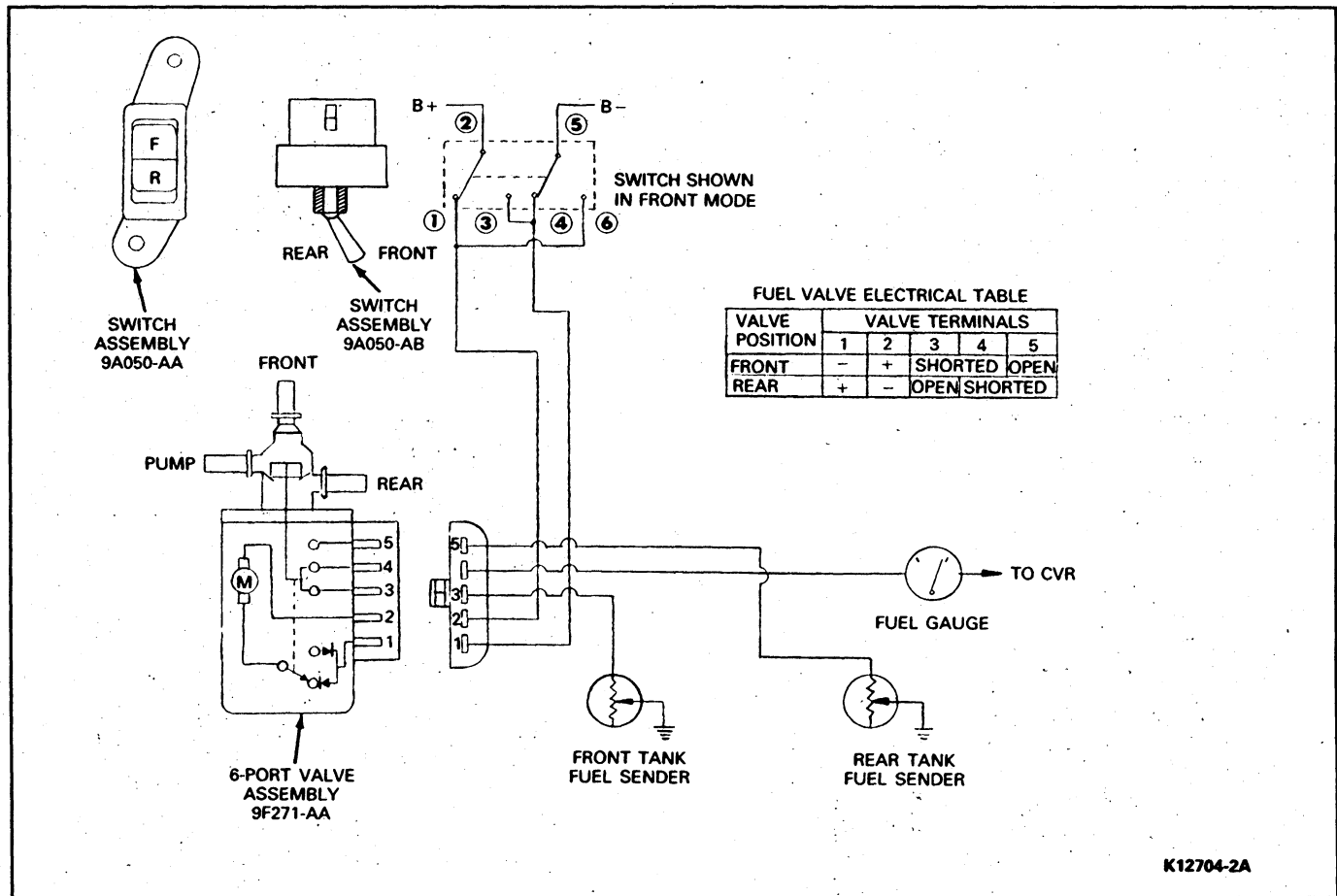


FIG. 8 Fuel Tank Selector Switch Circuit—7.3L Diesel

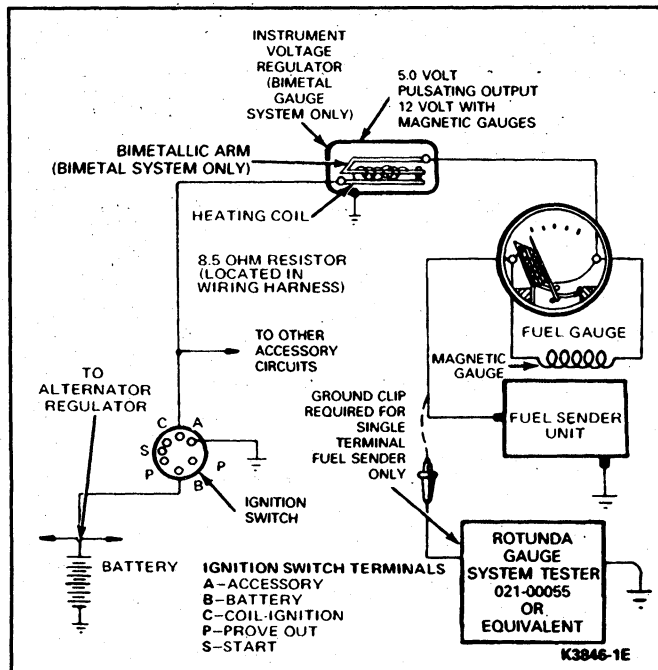


FIG. 9 Fuel Indicating System Test with Rotunda Tester 021-00055 or Equivalent—Econoline

- Remove the two nuts attaching the gauge to the cluster, and remove gauge.

**CAUTION: Do not touch gauge pointer.**

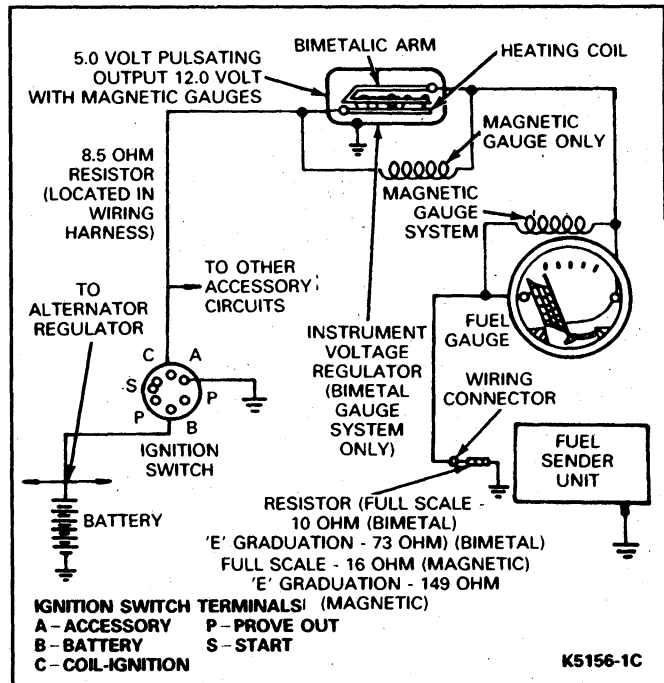


FIG. 10 Fuel Indicating System Test—Using 22 or 73 Ohm Resistor—Econoline

#### Installation

- To install, reverse Steps 1 through 4. Check gauge operation.

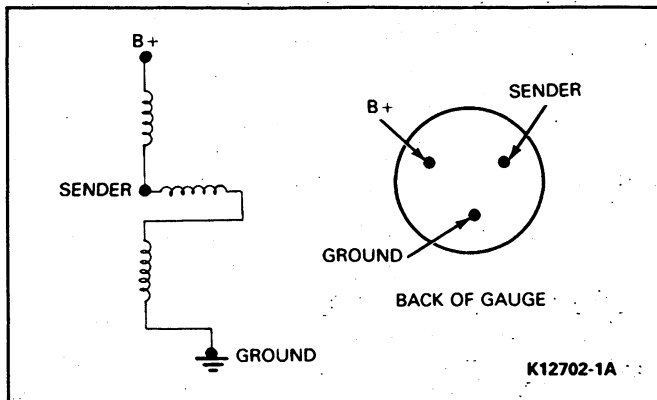


FIG. 11 Fuel Gauge Bench Test Connection Points

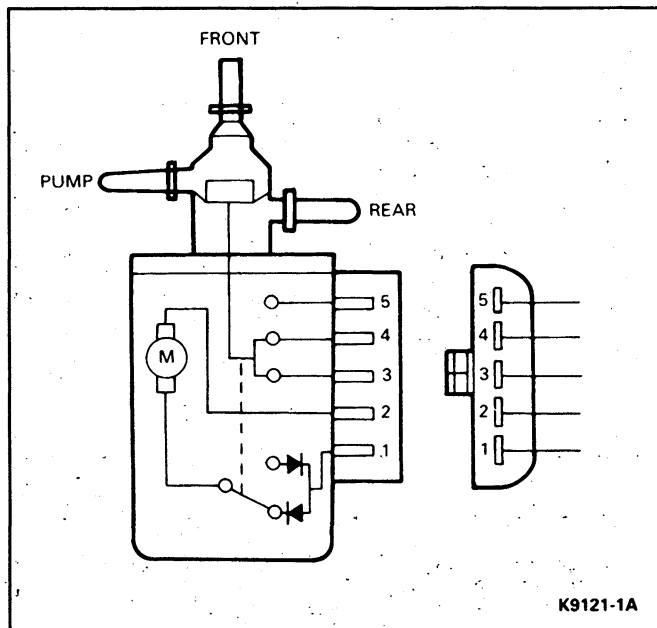


FIG. 12 Fuel Selector Valve—6-Port—Terminal Numbers (7.3L Diesel)

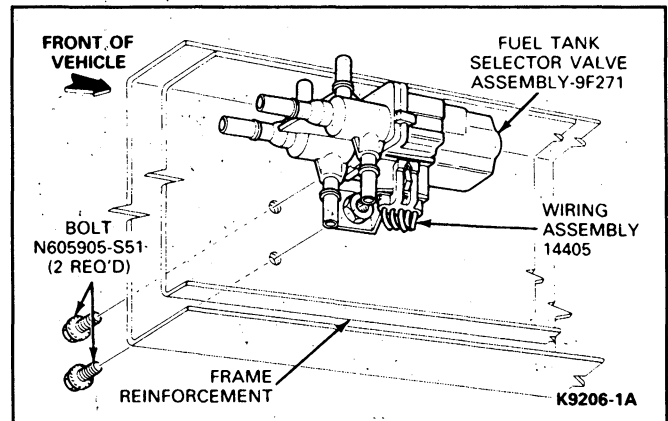


FIG. 13 6-Port Fuel Tank Selector Valve—F-Series (7.3L Diesel)

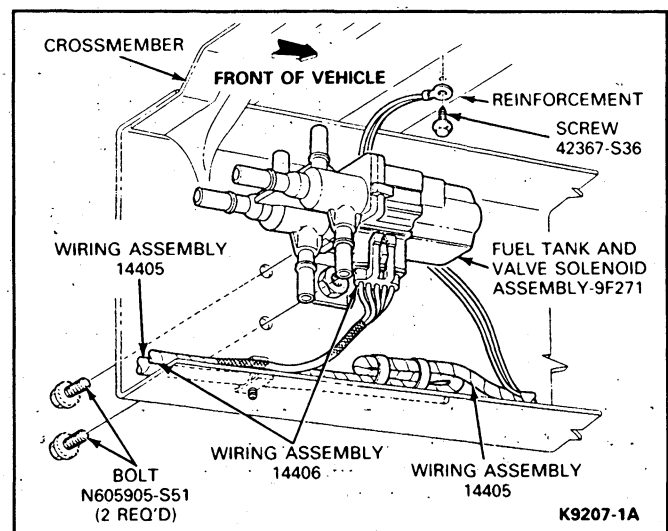


FIG. 14 6-Port Fuel Tank Selector Valve—Econoline (7.3L Diesel)

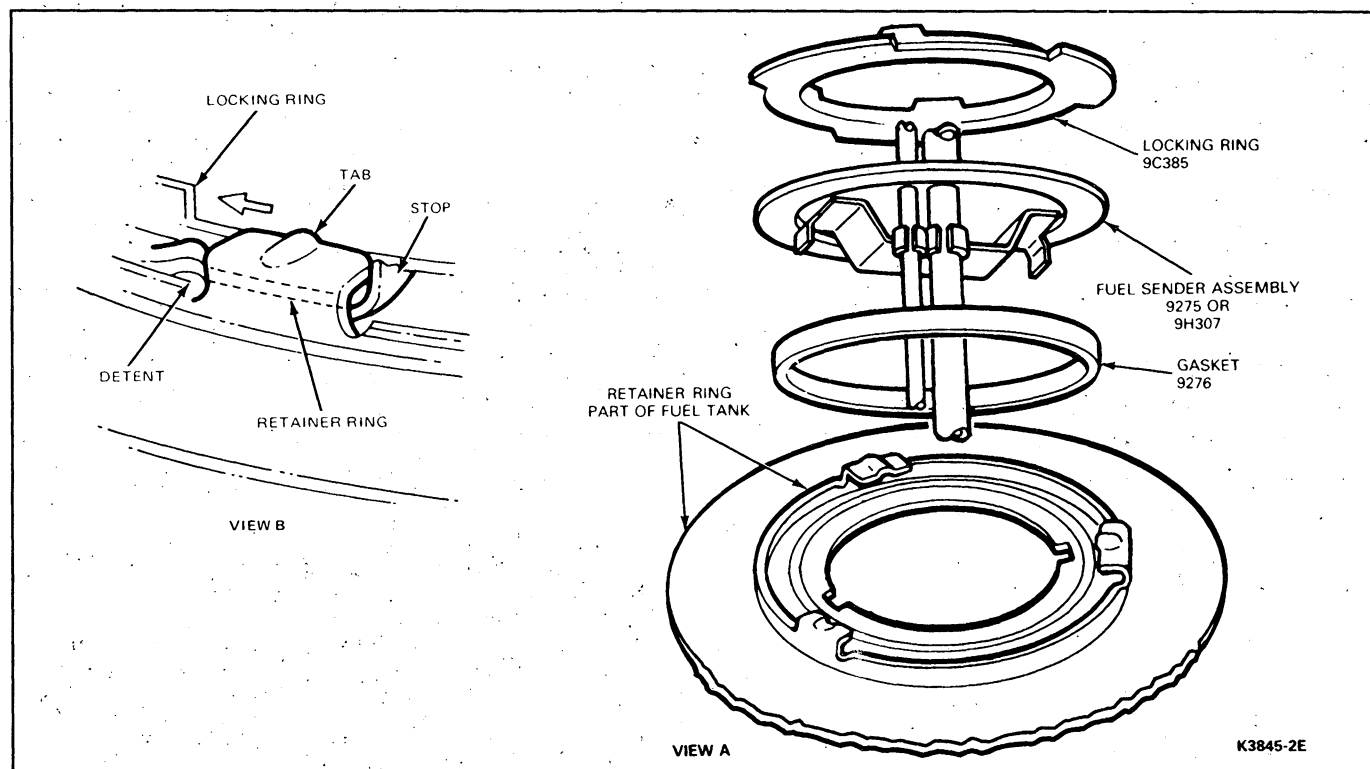


FIG. 15 Fuel Tank Sender Installation (Metal Lock Ring Type)

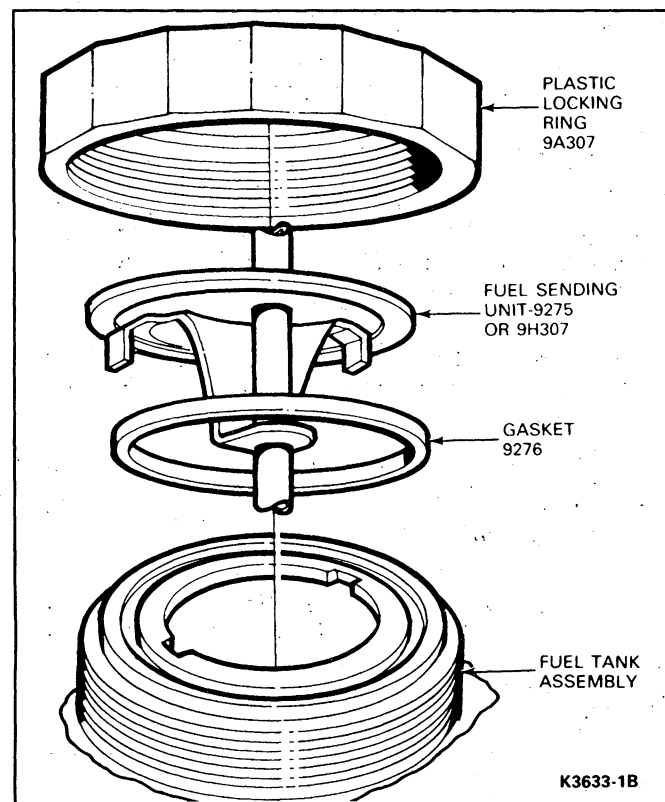


FIG. 16 Fuel Tank Sender Installation (Plastic Locking Ring Type)—F-350 and F-Super Duty Chassis Cab

## SPECIAL SERVICE TOOLS

Tool	Description
T74P-9275-A	Fuel Tank Sender Wrench

CK6222-1C

## ROTUNDA EQUIPMENT

Model	Description
021-00055	Instrument Gauge System Tester
007-00001	Digital Volt Ohm Meter

CK6351-1F



# SECTION 33-32 Oil Pressure Gauge

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd)	
System Operation .....	33-32-1	Sending Unit .....	33-32-2
DIAGNOSIS AND TESTING .....	33-32-1	SPECIAL SERVICE TOOLS .....	33-32-4
REMOVAL AND INSTALLATION		SPECIFICATIONS .....	33-32-4
Oil Pressure Gauge .....	33-32-2	VEHICLE APPLICATION .....	33-32-1
E-150—E-350 .....	33-32-2		
F-150 Through F-350, F-Super Duty and Bronco .....	33-32-2		

## VEHICLE APPLICATION

All Models.

## DESCRIPTION AND OPERATION

### System Operation

#### Magnetic Gauge System

Refer to Figs. 1 and 2.

The magnetic gauge movement consists of three primary coils, one of which is wound at a 90 degree angle to the other two. The coils form a magnetic field which varies in direction according to the variable

resistance of the sender unit which is connected between two of them. A primary magnet, to which a shaft and pointer are attached, rotates to align to this primary field, resulting in pointer position. The bobbin/coil assembly is pressed into a metal housing which has two holes for dial mounting. There is no adjustment, calibration or maintenance required for these gauges.

NOTE: An instrument voltage regulator (IVR) is not required for this system.

## DIAGNOSIS AND TESTING

Refer to the following charts for magnetic gauge diagnosis.

### OIL GAUGE INOPERATIVE — INACCURATE PINPOINT TEST A

TEST STEP		RESULT	ACTION TO TAKE
<b>A1</b>	VERIFY CONDITION		
	<ul style="list-style-type: none"> <li>Verify Condition.</li> </ul>	Gauge pointer does not move Gauge pointer moves	GO to B2. GO to B1.
<b>A2</b>	CHECK OTHER GAUGES		
	<ul style="list-style-type: none"> <li>Check power to cluster. With ignition on, observe other gauges and warning lamps for proper operation. If necessary, use voltmeter or test lamp to verify voltage at B+ terminal of cluster connector.</li> </ul>	Other gauges and warning lamps operate correctly; voltage present at cluster Other gauges and warning lamps do not operate correctly; no voltage present at cluster	GO to B1. SERVICE wiring to cluster.

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### OIL GAUGE INACCURATE PINPOINT TEST B

TEST STEP		RESULT	ACTION TO TAKE
<b>B1</b>	<b>TEST BOX CHECK</b>		
	<ul style="list-style-type: none"> <li>Insert Instrument Gauge, System Tester, Rotunda 021-00055 or equivalent in sender circuit. Disconnect connector at sender and connect tester to cluster side of connector. Set tester to LOW (73 ohms).</li> </ul>	Gauge reads L Pointer does not move	GO to B2. GO to B3.
<b>B2</b>	<b>TEST BOX CHECK</b>		
	<ul style="list-style-type: none"> <li>Set tester to HIGH (22 ohms).</li> </ul>	Gauge reads mid-scale Gauge does not read mid-scale	REPLACE sender. GO to B3.
<b>B3</b>	<b>CHECK SENDER WIRING</b>		
	<ul style="list-style-type: none"> <li>Check sender circuit wiring for shorts or open with ohmmeter.</li> </ul>	(OK) (X)	REPLACE gauge. SERVICE wiring.

CK10200-2C

## REMOVAL AND INSTALLATION

### Sending Unit

The oil pressure sending units are mounted in different ways and locations. Fig. 3 is a typical example for gasoline engines. Fig. 4 shows the installation for the 7.3L diesel engine.

To remove the sending unit, disconnect the wire at the unit terminal and unscrew the unit from its mounting. Install the new sending unit and tighten to 11-24 N·m (8-18 ft-lb). Connect the wire to the unit terminal and check the operation of the unit.

**CAUTION:** Be sure to use electrically conductive water-resistant sealer on the threads of the unit. The pressure switch-type unit used with the indicator lamp system is not interchangeable with the variable resistance-type unit called a sender, which is used with the gauge system. Refer to the Master Parts Catalog for proper parts usage. Installation of the wrong part will result in an

inoperative oil pressure indicating system and a damaged sender unit, IVR or gauge.

### Oil Pressure Gauge

#### E-150—E-350

Remove the instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit. Then remove the housing, mask and lens from the front of the cluster by removing the retaining screws. Remove the oil pressure gauge retaining nuts and remove the gauge. To install, position the oil pressure gauge and install the retaining nuts. Install the mask, lens and housing to the front side of the cluster and install the retaining screws. Install the instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit.

#### F-150 Through F-350, F-Super Duty and Bronco

Remove the instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit. Then, remove the lens and mask from the cluster. Remove the two nuts attaching the gauge to the cluster, and remove the gauge. To install, reverse the removal procedure.

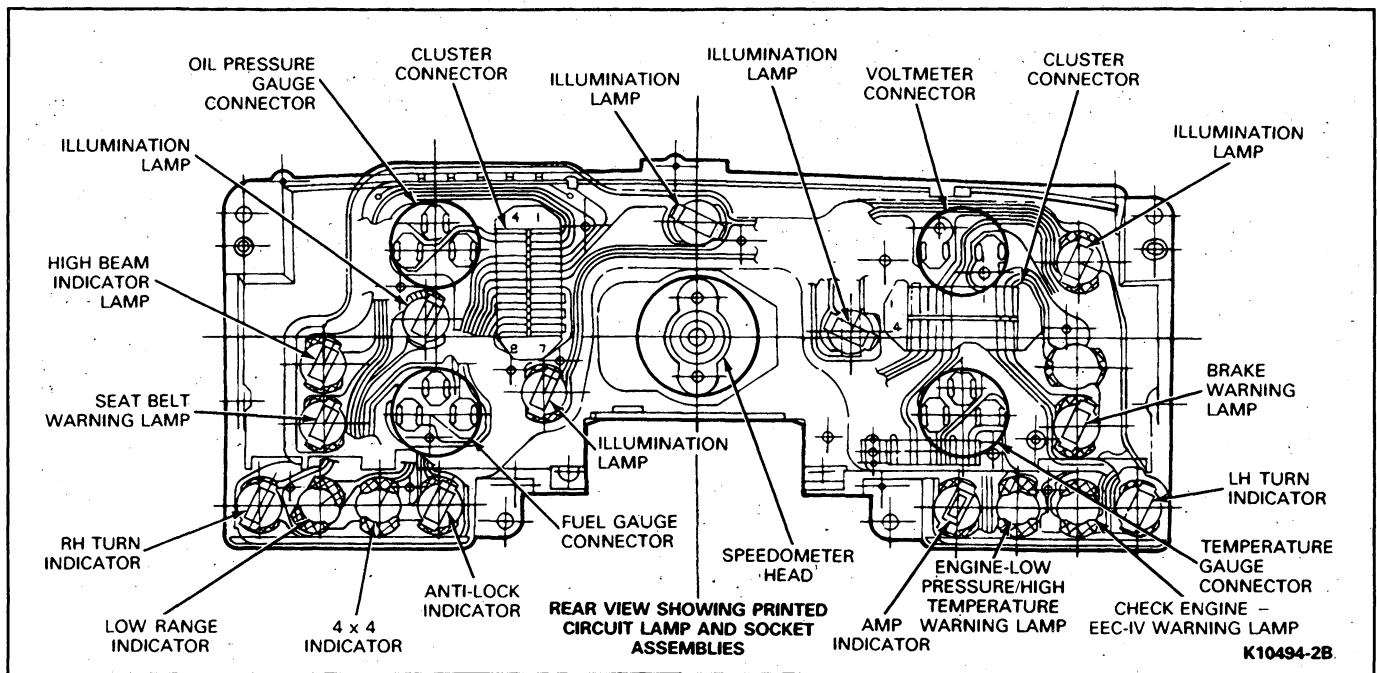


FIG. 1 Oil Pressure Gauge Location

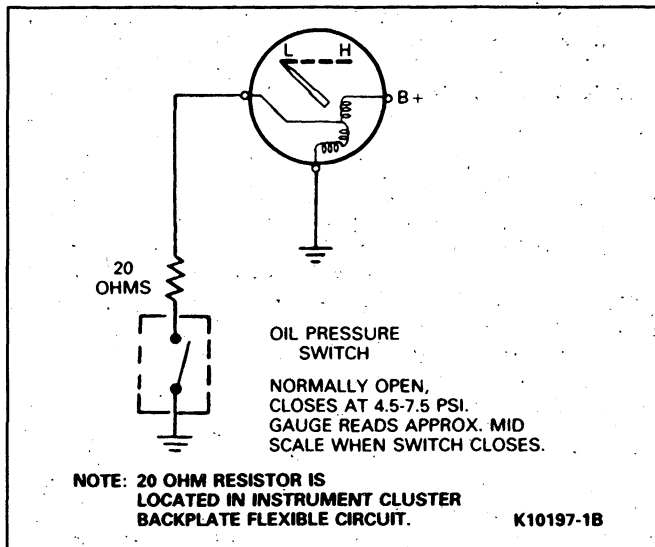


FIG. 2 Oil Pressure Indicating System Schematic

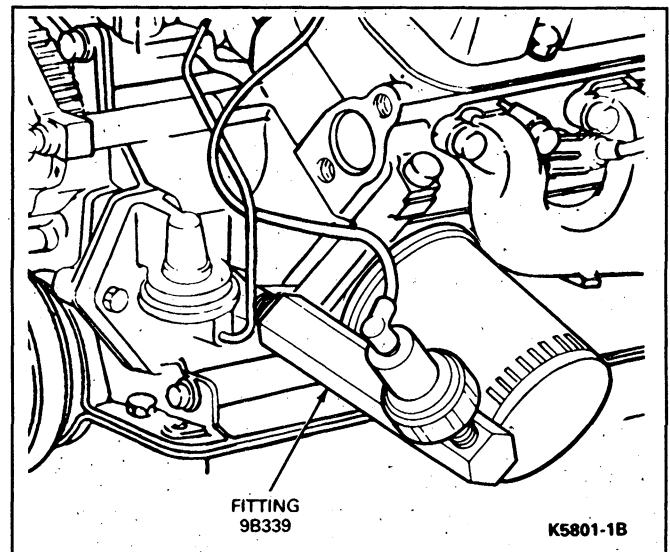


FIG. 3 Typical Oil Pressure Sender Unit 8-Cylinder—5.0L (302 CID) and 5.8L (351 W) Engines Shown

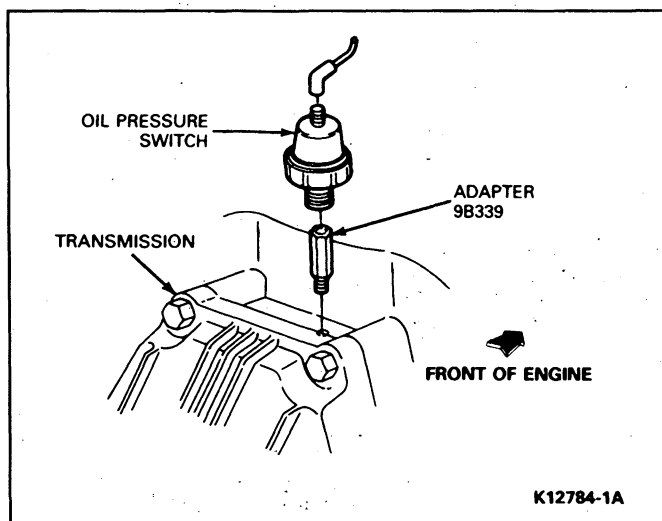


FIG. 4 Oil Pressure Sender Unit—7.3L Diesel Engine

## SPECIFICATIONS

### ALL GAUGES

Size (Less Terminals)	29mm diameter x 25mm length (1.4 in. diameter x 1 in. length)
Weight (Less Dial and Pointer)	40 grams (1.4 ounces)
Mounting	Flange on Steel Body
Operating Temperature	-30°C to 80°C (-86°F to 176°F)
Pointer Travel	85° (Fuel) 90° (Temp and Oil)
Electrical Connection	Three Pin Terminals
Operating Voltage	11-16 VDC

CK10426-1A

## SPECIAL SERVICE TOOLS

### ROTUNDA EQUIPMENT

Model	Description
021-00055	Instrument Gauge System Tester
007-00001	Digital Volt Ohm Meter

CK6351-1F

# SECTION 33-41 Temperature Indicator

SUBJECT	PAGE	SUBJECT	PAGE
<b>DIAGNOSIS AND TESTING</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Cleaning .....	33-41-3	Temperature Sending Unit .....	33-41-1
<b>REMOVAL AND INSTALLATION</b>		<b>SPECIAL SERVICE TOOLS</b> .....	33-41-4
Coolant Temperature Gauge .....	33-41-1	<b>VEHICLE APPLICATION</b>	
E-150—E-350 .....	33-41-1	Magnetic Gauges—F-Series and	
F-150 Through F-350 and Bronco .....	33-41-1	Bronco .....	33-41-1

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350, F-Super Duty and Bronco.

Bimetal Gauges and IVR — E-Series

The instrument voltage regulator (IVR) used with the bimetal gauge system supplies a common regulated voltage for fuel, temperature, and oil pressure gauges. The IVR can only be defective if all of the gauges exhibit similar problems such as fluctuating movement or high or low indication. If so, refer to the gauge and IVR regulator operational test before proceeding with a calibration test.

## Magnetic Gauges—F-Series and Bronco

### Fuel, Temperature and Oil Pressure

The magnetic gauge movement consists of three primary coils, one of which is wound at a 90 degree angle to the other two. The coils form a magnetic field which varies in direction according to the variable resistance of the sender unit which is connected between two of them. A primary magnet, to which a shaft and pointer are attached, rotates to align to this primary field, resulting in pointer position. The bobbin/coil assembly is pressed into a metal housing which has two holes for dial mounting. There is no adjustment, calibration or maintenance required for these gauges. Refer to Fig. 1.

NOTE: An instrument voltage regulator (IVR) is not required for this system. Refer to Diagnostic procedure.

## REMOVAL AND INSTALLATION

### Temperature Sending Unit

#### Removal and Installation

1. Remove cap from radiator to relieve any pressure and then replace cap. This reduces coolant loss during sender replacement.
2. Disconnect the temperature sending unit wire at the sending unit (Figs. 2 and 3).
3. Prepare the new temperature sending unit for installation by applying Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G194-A, ESR-M18P7-A) or equivalent, or a small amount of electrically conductive sealer to the threads.
4. Remove the temperature sending unit from the cylinder head and immediately install the new temperature sending unit. Tighten to 11-24 N·m (8-18 ft-lb).

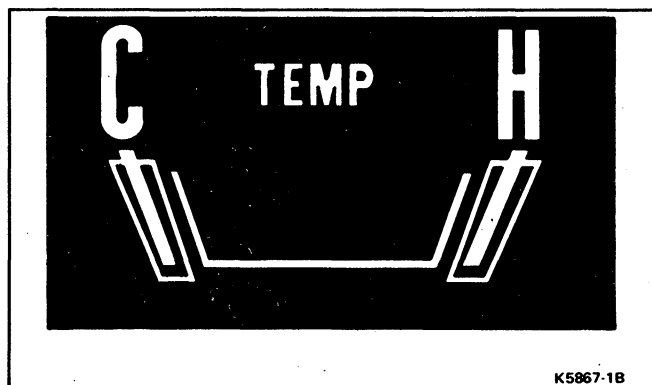


FIG. 1 Coolant Temperature Gauge System (Typical)

5. Connect the wire to the temperature sending unit.
6. Refill cooling system to replace lost coolant.
7. Start the engine and check the sending unit operation.

## Coolant Temperature Gauge

### Removal and Installation

#### E-150—E-350

Remove the instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit. Then remove the housing, mask and lens from the front of the cluster by removing the retaining screws. Remove the coolant temperature gauge retaining nuts and remove the gauge. To install, position the coolant temperature gauge and install the retaining nuts. Install the mask, lens and housing to the front side of the cluster and install the retaining screws.

#### F-150 Through F-350 and Bronco

Remove the instrument cluster. Refer to Section 33-51, Instrument Cluster and Printed Circuit. Then, remove the lens and mask from the cluster. Remove the two nuts attaching the gauge to the cluster, and remove the gauge. To install, reverse the removal procedure.

## DIAGNOSIS AND TESTING

For diagnosis and testing of the temperature gauge and sending unit, use a test lamp and Rotunda Instrument Gauge System Tester 021-00055 or equivalent. Refer to Figures 4 and 5, and the diagnosis guides for the test schematics and steps to check the gauge and sending unit.

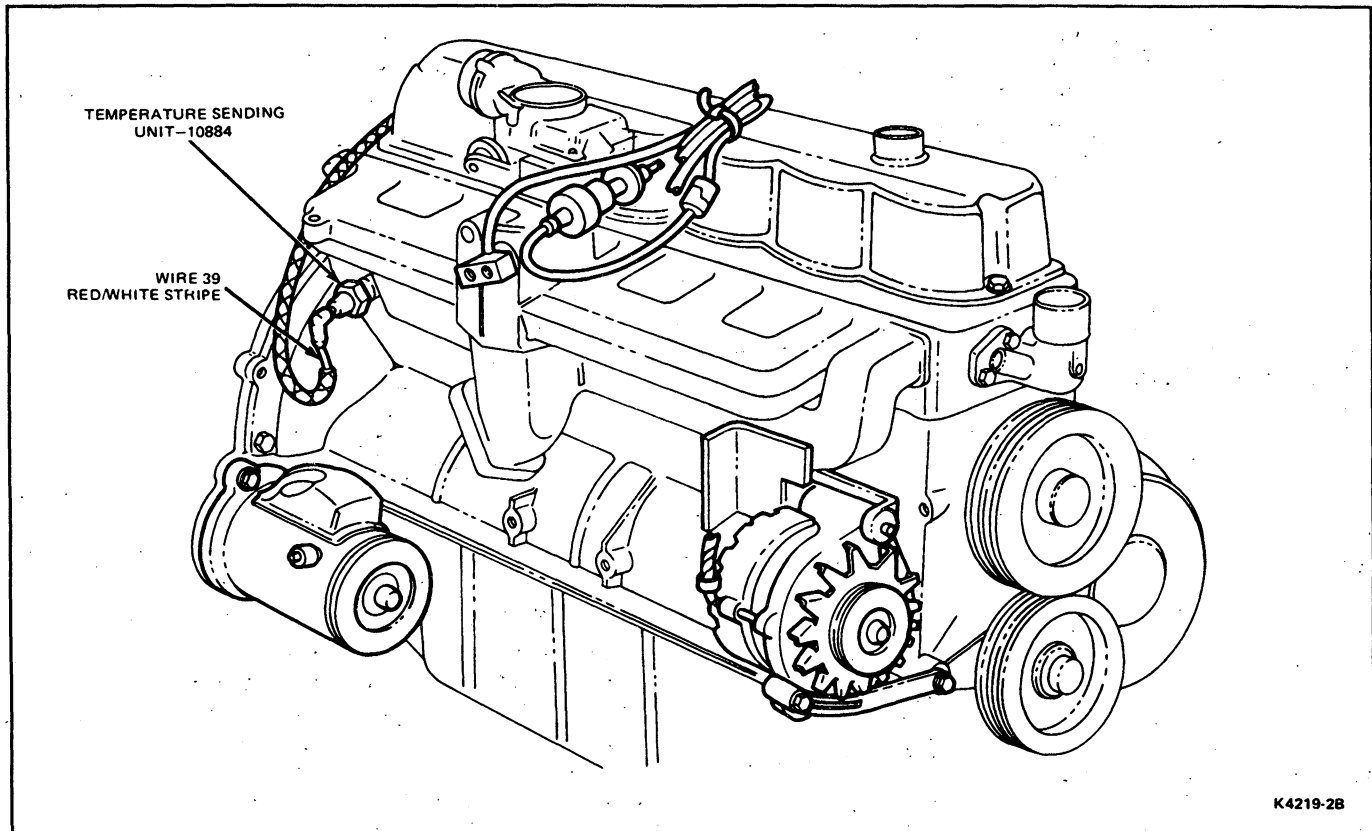


FIG. 2 Temperature Sending Unit—6 Cylinder—E-150—E-350 Shown, F-150—F-350, F-Super Duty and Bronco Similar

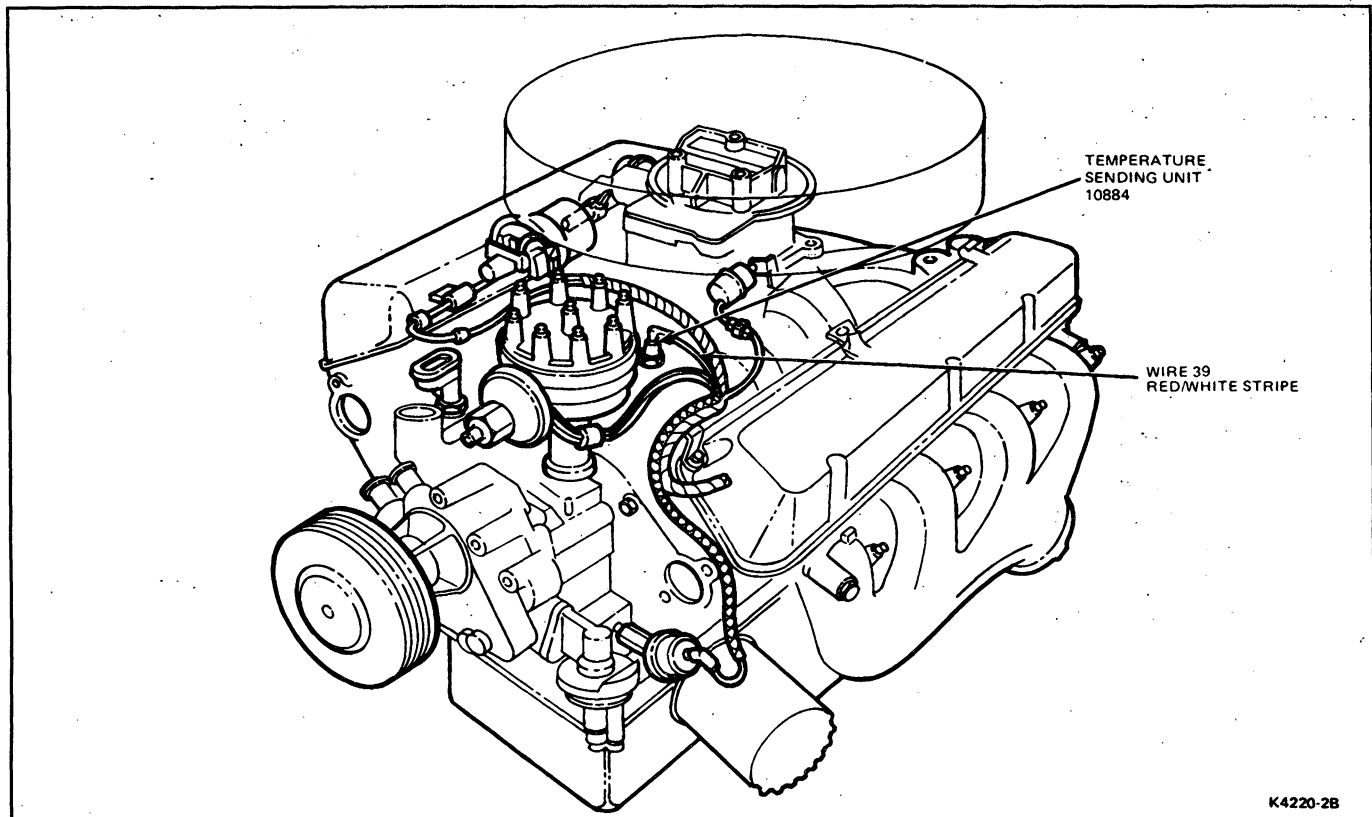
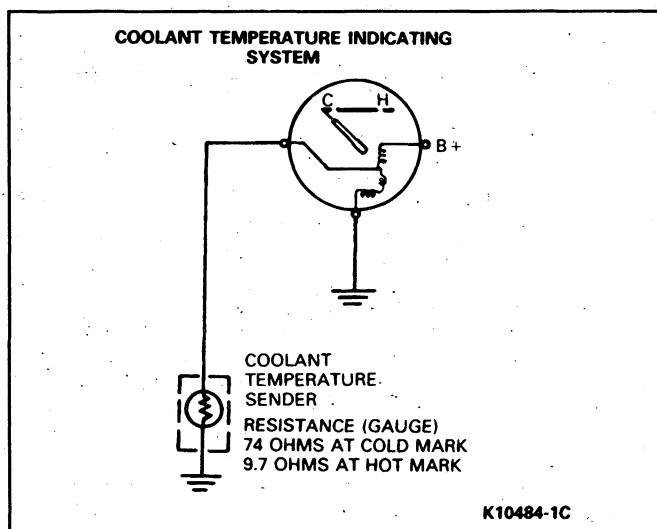
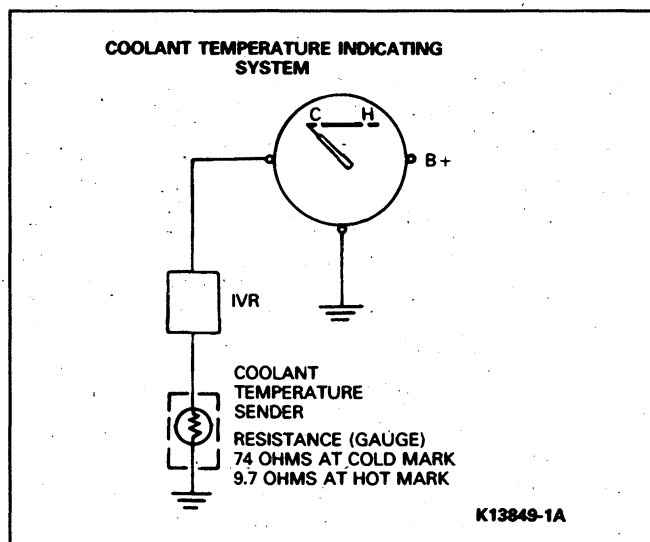


FIG. 3 Temperature Sending Unit—8 Cylinder—E-150—E-350 5.8L (351 C.I.D.) Shown—Other Models and 8 Cylinder Engines Similar



**FIG. 4 Coolant Temperature System (Typical Magnetic Gauge)**



**FIG. 5 Coolant Temperature System (Typical Bimetal Gauge and IVR)**

### Cleaning

**CAUTION:** The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (O-dichlorobenzene, ethyl alcohol and/or Cellosolve), has produced fogging, spotting, stain, or splotches of the lenses, either through over-spray or direct use on the lenses. Therefore, extreme caution should be taken during interior

cleanup to prevent over-spray of cleaning agents which contain the chemical contents mentioned from contacting the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ford Glass Cleaner E4AZ-19C507-A (ESR-M14P5-A) or equivalent commercial cleaning product, using a clean, soft, lint-free cloth. The Ford Glass Cleaner has been specially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow the directions shown on the container for best results.

### TEMP GAUGE INOPERATIVE — POINTER DOES NOT MOVE PINPOINT TEST A

TEST STEP		RESULT	ACTION TO TAKE
<b>A1</b>	<b>VERIFY CONDITION</b>		
	<ul style="list-style-type: none"> <li>Verify Condition.</li> </ul>	Gauge pointer does not move → Gauge pointer moves →	GO to A2. GO to B1.
<b>A2</b>	<b>CHECK OTHER GAUGES</b>		
	<ul style="list-style-type: none"> <li>Check power to cluster. With ignition on, observe other gauges and warning lamps for proper operation. If necessary, use voltmeter or test lamp to verify voltage at B+ terminal of cluster connector.</li> </ul>	Other gauges and warning lamps operate correctly; voltage present at cluster → Other gauges and warning lamps do not operate correctly; no voltage present at cluster →	GO to B1. SERVICE power to cluster — wiring.

CK10485-2B

### TEMP GAUGE INACCURATE PINPOINT TEST B

TEST STEP		RESULT	ACTION TO TAKE
<b>B1</b>	<b>TEST BOX CHECK</b>		
	<ul style="list-style-type: none"> <li>Insert Instrument Gauge, System Tester, Rotunda 021-00055 or equivalent in sender circuit. Disconnect connector at sender and connect tester to cluster side of connector. Set tester to LOW (73 ohms).</li> </ul>	Gauge reads C Pointer does not move	GO to B2. GO to B3.
<b>B2</b>	<b>TEST BOX CHECK</b>		
	<ul style="list-style-type: none"> <li>Set tester to HIGH (9.7 ohms).</li> </ul>	Gauge reads H Gauge does not read H	REPLACE sender. GO to B3.
<b>B3</b>	<b>CHECK SENDER WIRING</b>		
	<ul style="list-style-type: none"> <li>Check sender circuit wiring for shorts or open with ohmmeter.</li> </ul>	OK <del>OK</del>	REPLACE gauge. SERVICE wiring.

CK10486-2B

#### ALL GAUGES

Size (Less Terminals)	29 mm diameter x 25 mm length (1.4 in diameter x 1 in length)
Weight (Less Dial and Pointer)	40 grams (1.4 ounces)
Mounting	Flange on Steel Body
Operating Temperature	-30°C to 80°C (-86°F to 176°F)
Pointer Travel	90° (Temp Gauge)
Electrical Connection	Three Pin Terminals
Operating Voltage	11-16 VDC

CK10482-1A

#### SPECIAL SERVICE TOOLS

##### ROTUNDA EQUIPMENT

Model	Description
021-00055	Instrument Gauge System Tester
007-00001	Digital Volt Ohm Meter

CK6351-1F



# SECTION 33-51 Instrument Cluster and Printed Circuit

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Cluster Assembly .....	33-51-1	Instrument Cluster Opening Finish Panels and Center Finish Panel .....	33-51-1
E-150—E-350 .....	33-51-1	Instrument Voltage Regulator and Printed Circuit .....	33-51-5
F-150 Through F-350, F-Super Duty and Bronco .....	33-51-2	Printed Circuit Cluster .....	33-51-6
Cluster Opening Finish Panels .....	33-51-1	<b>VEHICLE APPLICATION</b> .....	33-51-1
Instrument Cluster Illumination and Indicator Bulbs—F-150—F-350, F-Super Duty Bronco and E-150—E-350 .....	33-51-7		

## VEHICLE APPLICATION

E-150-E-350, F-150-F-350, F-Super Duty and Bronco.

## REMOVAL AND INSTALLATION

**CAUTION:** The use of vinyl cleaners and similar other cleaning agents to clean the vehicle interior and/or instrument cluster lenses has resulted in damage to the instrument cluster lenses. The chemical content of these cleaning agents (O-dichlorobenzene, ethyl alcohol and/or Cellosolve), has produced fogging, spotting, stain, or splotches of the lenses, either through over-spray or direct use on the lenses. Therefore, extreme caution should be taken during interior cleanup to prevent over-spray of cleaning agents which contain the chemical contents mentioned from contacting the instrument cluster lenses.

The instrument cluster lenses should be cleaned with Ultra Clear Spray Glass Cleaner E4AZ-19C507-AA (ESR-M14P5-A) or equivalent commercial cleaning product, using a clean, soft, lint-free cloth. The Ford Glass Cleaner has been specially formulated for cleaning windows in automotive vehicles and is approved for use in cleaning the plastic instrument cluster lenses. Read and carefully follow the directions on the container for best results.

### Instrument Cluster Opening Finish Panels and Center Finish Panel

There are four finish panels which attach to the instrument panel (Fig. 1). They are:

- An instrument cluster opening upper finish panel assembly.
- An instrument cluster finish panel assembly which attaches on the RH side of the steering column opening.
- An instrument cluster finish panel assembly which attaches on the LH side of the steering column opening.
- An instrument center finish panel assembly.

## Cluster Opening Finish Panels

### Removal

1. Remove six screws attaching upper cluster opening finish panel to instrument panel.
2. Pull panel rearward to release two mounting tabs on forward side of finish panel from retaining slots in instrument panel.
3. Remove the finish panel.
4. Disconnect one screw securing RH lower finish panel to instrument panel.
5. Pull finish panel rearward to release locating pin and two tangs from respective hole and slots in instrument panel.
6. Remove finish panel.
7. Pull rearward on LH finish panel to release it from two locating pin holes and four slots in the instrument panel which match with attaching tang locations on the finish panel.
8. Remove finish panel.

### Installation

1. If all three finish panels have been removed, begin installation with upper cluster opening finish panel. Install six attaching screws.
2. Install RH finish panel by aligning it with locating pin hole and two attaching slots. Press finish panel into engagement with instrument panel.
3. Install one attaching screw for RH finish panel.
4. Install LH finish panel by aligning two pins and four attaching tangs with mating holes and slots in instrument panel. Press finish panel into engagement with instrument panel.

## Cluster Assembly

Refer to Figs. 2, 3 and 4

### E-150—E-350

#### Removal

1. Disconnect the battery ground cable.
2. Remove seven instrument cluster-to-panel retaining screws (Fig. 2).

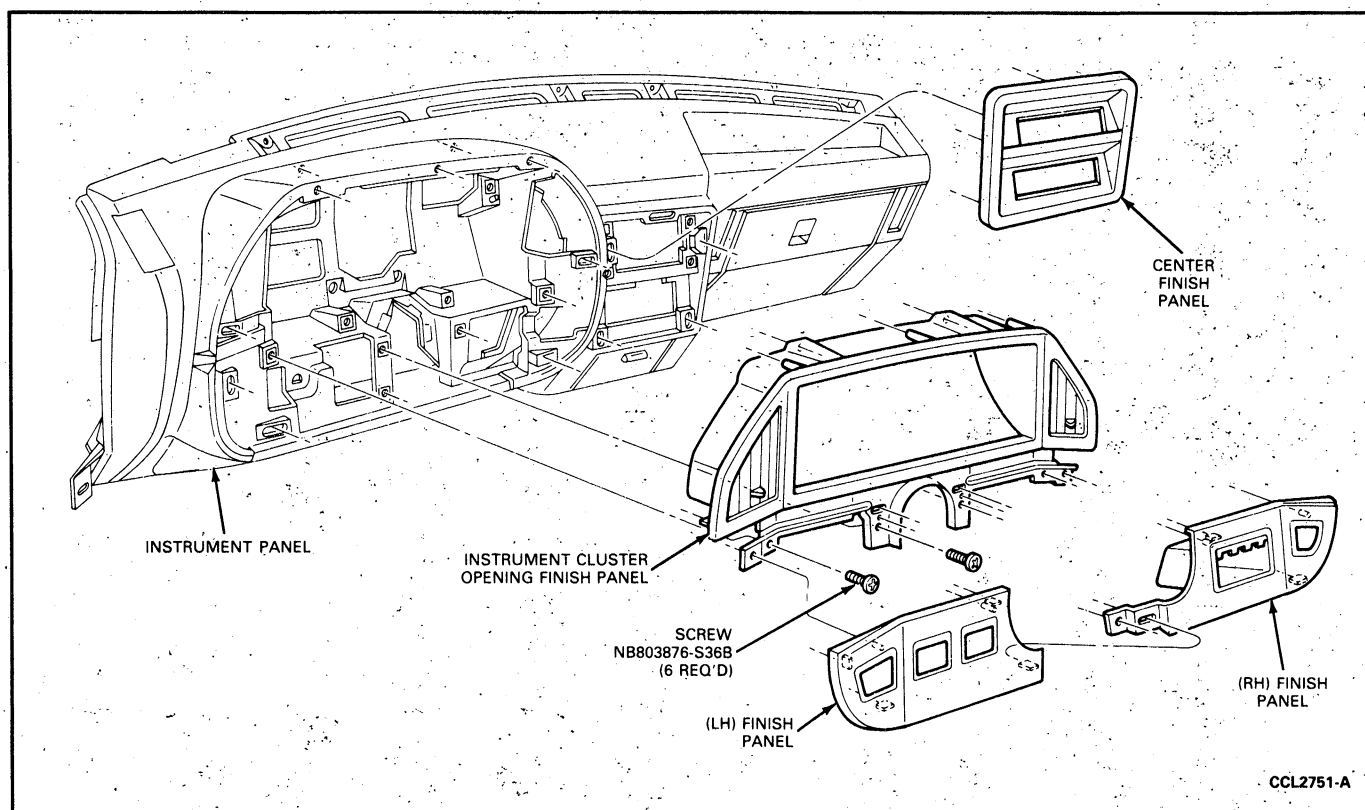


FIG. 1 Instrument Panel Finish Panel

3. Position cluster slightly away from the panel for access to the back of the cluster to disconnect the speedometer (Fig. 4).

**If there is not sufficient access to disengage the speedometer cable from the speedometer, it may be necessary to remove the speedometer cable at the transmission and pull cable through cowl, to allow room to reach the speedometer quick disconnect.**

4. Disconnect the harness connector plug from the printed circuit and remove the cluster assembly from the instrument panel.

#### Installation

1. Apply approximately 4.8 mm (3/16-inch) diameter ball of Silicone Dielectric Compound D7AZ-19A331-A (ESE-M1C171-A) or equivalent in the drive hole of the speedometer head.
2. Position the cluster near its opening in the instrument panel.
3. Connect the harness connector plug to the printed circuit board.
4. Connect the speedometer cable (quick disconnect) to the speedometer head (Fig. 4).

**Connect the speedometer cable and housing assembly to the transmission, if removed.**

5. Install the seven instrument cluster-to-panel retaining screws and connect the battery ground cable (Fig. 2).
6. Check operation of all gauges, lamps, and signals.

#### F-150 Through F-350, F-Super Duty and Bronco

Refer to Figs. 5, 6, 7 and 8

#### Removal

1. Disconnect the battery ground cable.
2. Remove the wiper-washer knob. Use a hook tool to release each knob lock tab.
3. Remove the knob from the headlamp switch. Remove the fog lamp switch knob, if so equipped.
4. Remove steering column shroud.

**CAUTION: Care must be taken not to damage transmission control selector indicator (PRNDL) cable on vehicles equipped with automatic transmission.**

5. On vehicles equipped with automatic transmission, remove loop on indicator cable assembly from retainer pin (Fig. 9). Remove bracket screw from cable bracket and slide bracket out of slot in tube.
6. Remove the cluster finish panel assembly. Remove four cluster attaching screws and disconnect the speedometer cable. Also, disconnect wire connectors from the printed circuit and remove the cluster.

#### Installation

1. Position cluster to opening and connect the two connectors. Connect the speedometer cable. Install the four cluster retaining screws.
2. On vehicles with automatic transmission, place loop on transmission indicator cable assembly over retainer on column.

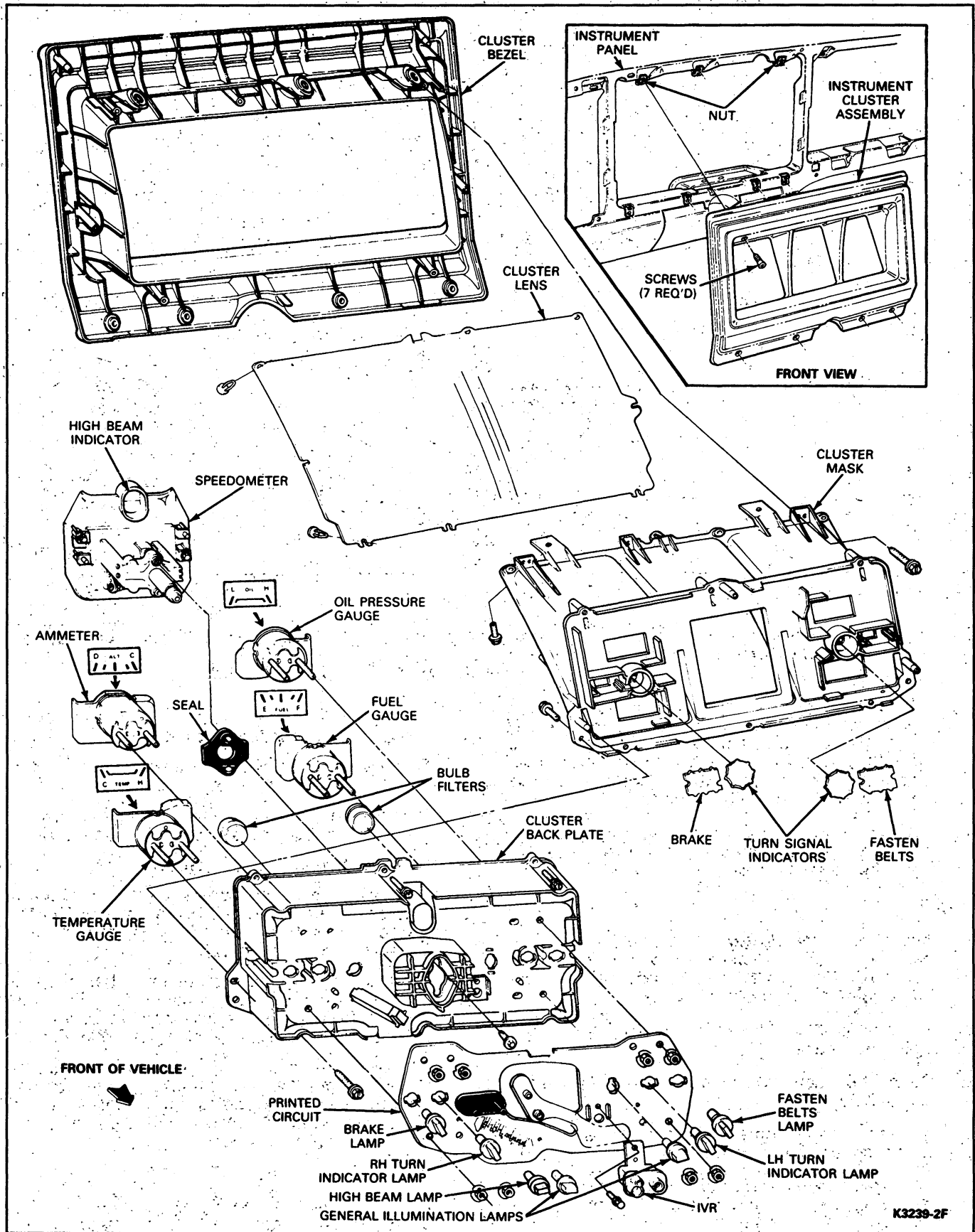
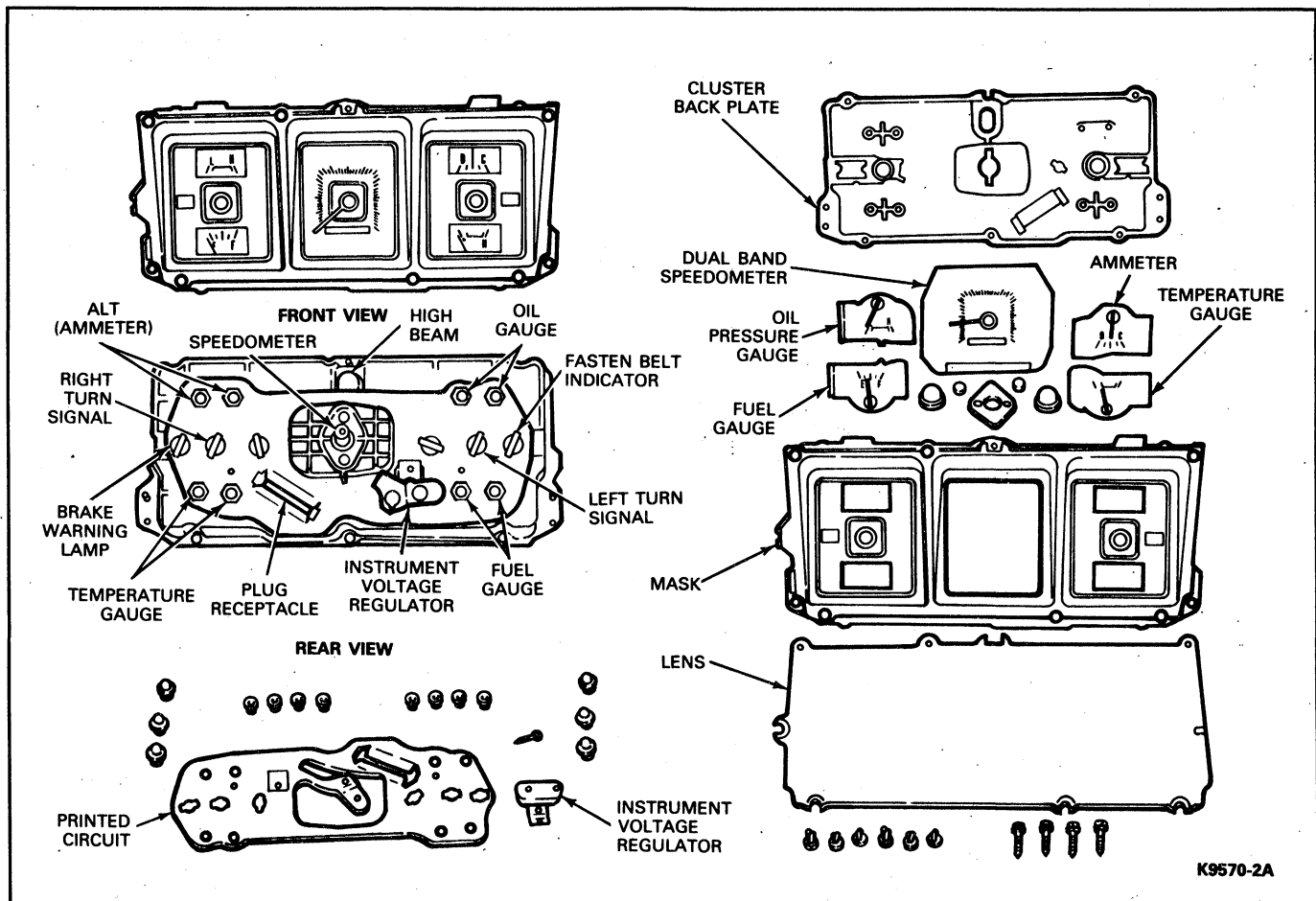


FIG. 2 Instrument Cluster—E-150—E-350



**FIG. 3 Instrument Cluster Disassembled—E-150—E-350**

3. Position the tab on the PRNDL cable bracket into slot on column. Align the PRNDL pointer and attach screw (Fig. 9).
4. With engine off and parking brake applied, place the transmission selector lever at steering column in "D" (DRIVE) (or Ⓢ for automatic overdrive transmissions) position. Hold lever against the "D" (or Ⓢ for AOD transmissions) stop using an approximate 3.6 kg (8 lb) weight attached to the selector lever knob. Use Spring Scale T74P-3504-Y or equivalent.
5. Adjust PRNDL bracket to position the indicator in the rectangular adjustment band and attach screw, taking care not to move indicator.
6. Change the transmission lever to PARK position and check the PRNDL pointer. Shift transmission lever to all shift positions (PRND21 or PRNⓈD1) and check the PRNDL pointer position on each transmission shift position, verifying adjustment.

**NOTE:** The PRNDL should only be adjusted using the adjustment window in the primary drive (D position and not adjusted in any other position.

7. Install the trim finish panel assembly and column shroud.
8. Install the headlamp switch knob. If so equipped, install the fog lamp switch.
9. Install the wiper-washer control knobs.

10. Connect the battery cable. Check the operation of all gauges, lamps, signals and PRNDL pointer.

#### **Cluster Assembly—F-Super Duty Commercial Stripped Chassis and Motor Home Chassis Vehicles**

##### **Removal**

Refer to Fig. 10

1. Disconnect the battery ground cable(s).
2. Remove six cluster bezel-to-panel retaining screws and remove the cluster.
3. Disconnect two wiring harness connectors from backplate.
4. Disengage speedometer cable from speedometer.

##### **Installation**

1. Apply approximately 4.80mm (3/16 inch) diameter ball of D7AZ-19A331-A Silicone Dielectric compound or equivalent in the drive hole of the speedometer head.
2. Position the cluster near its opening in the instrument panel.
3. Connect the speedometer cable (quick disconnect) to the speedometer head. Connect the speedometer cable and housing assembly to the transmission (if removed).
4. Connect two wiring harness connectors to the backplate.

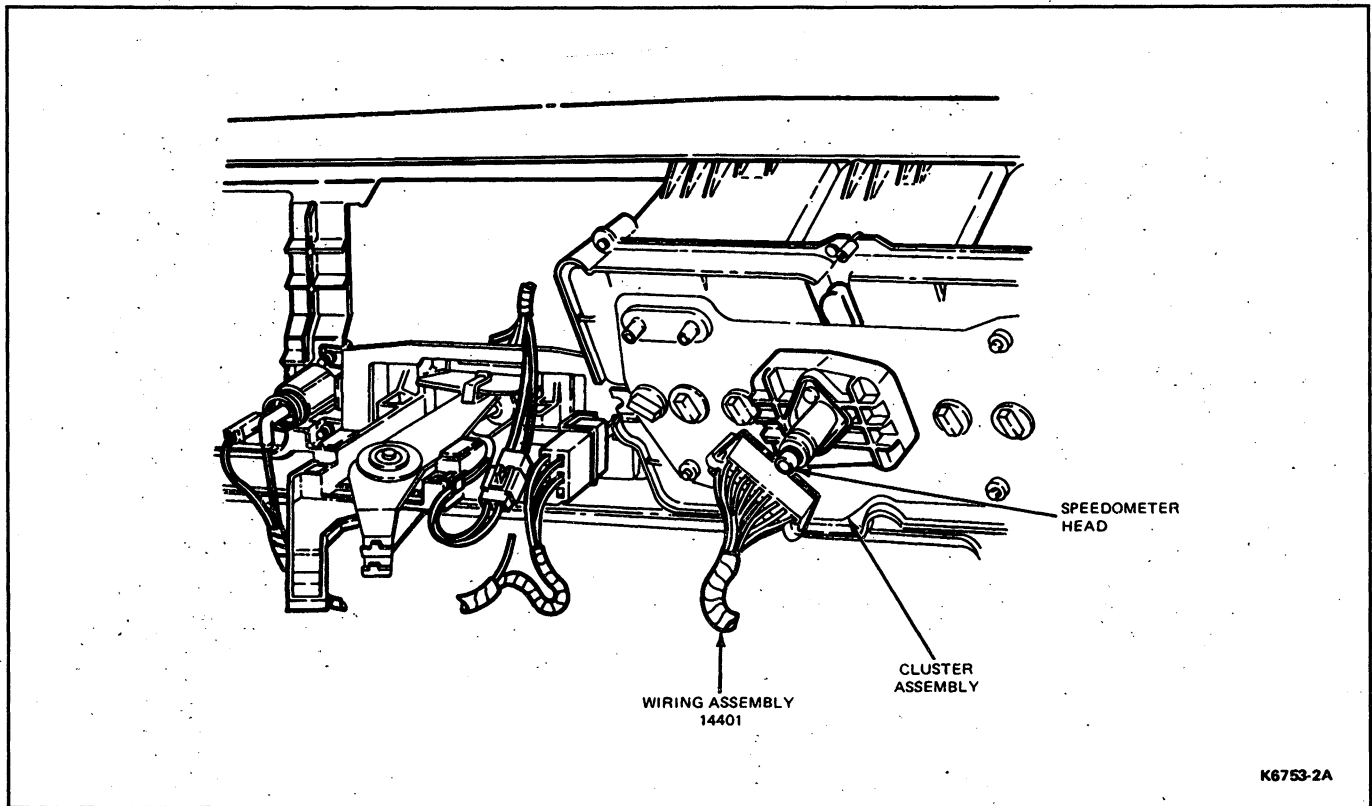


FIG. 4 Instrument Cluster Wiring—E-150—E-350

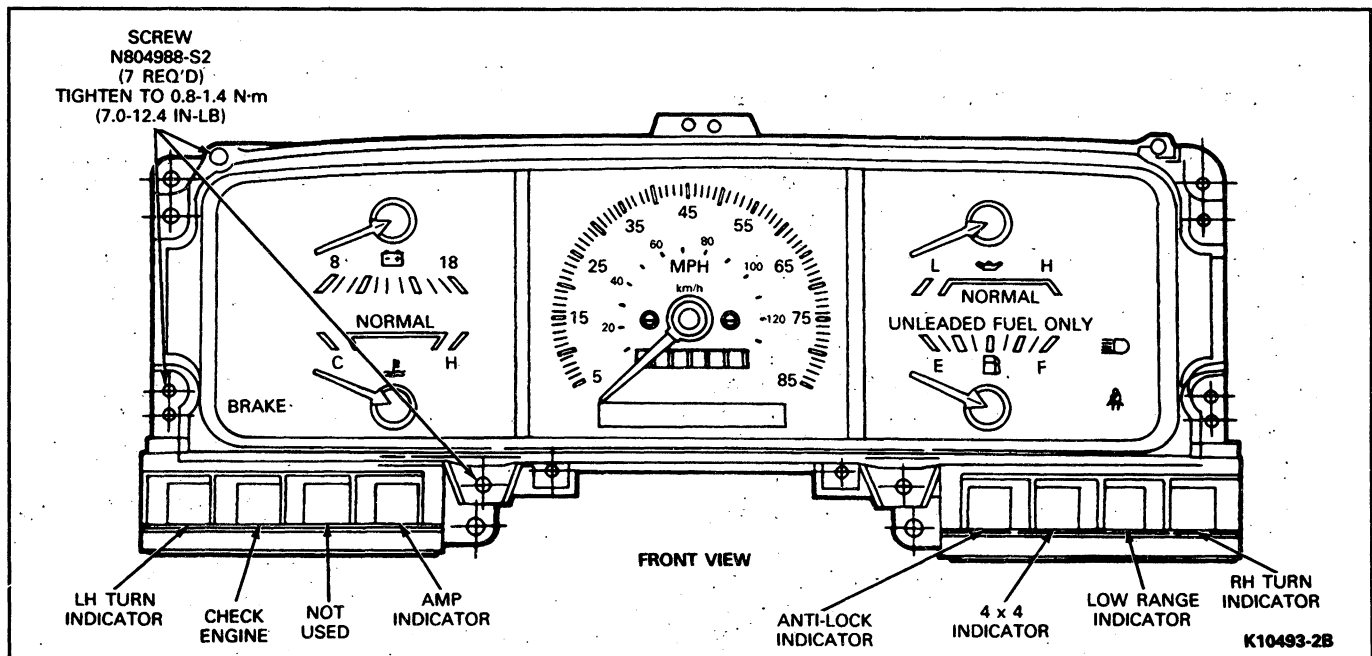


FIG. 5 Instrument Cluster—F-150—F-350, F-Super Duty and Bronco (Without Tachometer)

5. Position cluster to instrument panel and install the six cluster-to-panel retaining screws.
6. Connect the battery ground cable(s).
7. Check operation of all gauges and lamps.

#### Instrument Voltage Regulator and Printed Circuit

Refer to Figs. 2, 3 and 4.

#### Removal

1. Remove the instrument cluster assembly from the instrument panel as outlined.
2. Disconnect (snap off) the printed circuit connector buttons from the instrument voltage regulator (Fig. 3).
3. Remove the instrument voltage regulator (one screw).

4. Remove all retaining nuts and light bulbs (and resistor if present), and remove the printed circuit.

5. Install the cluster assembly as outlined. Check the operation of all gauges, lamps and signals.

### Installation

1. When installing the printed circuit, carefully position it to the back of the cluster and engage it to the plastic locating pins.
2. Install all retaining nuts, resistor and light bulbs.
3. Install the instrument voltage regulator (one screw).
4. Connect (snap on) the connector buttons to the instrument voltage regulator.

### Printed Circuit Cluster

#### F-Super Duty Commercial Stripped Chassis and Motor Home Chassis Vehicles

### Removal

Refer to Fig. 11.

1. Disconnect battery ground cable(s).
2. Remove the instrument cluster assembly from the instrument panel as outlined.

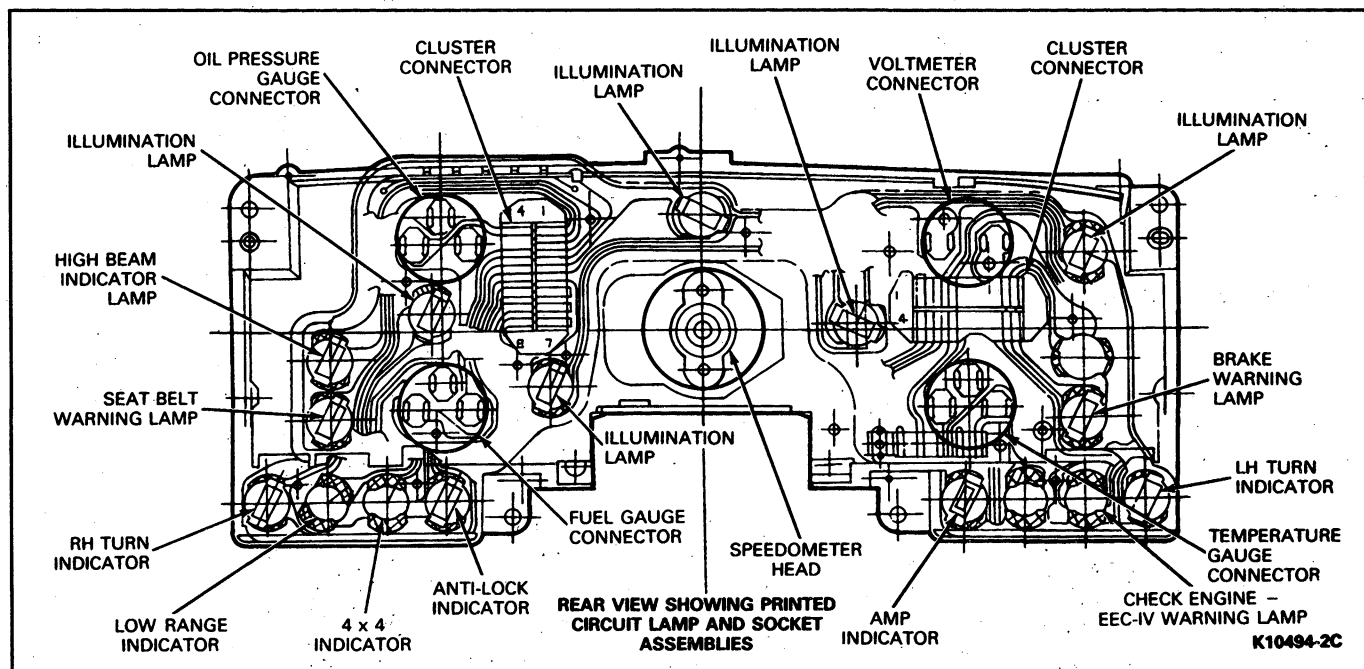


FIG. 6 Instrument Cluster Rear View—F-150—F-350, F-Super Duty and Bronco (Without Tachometer)

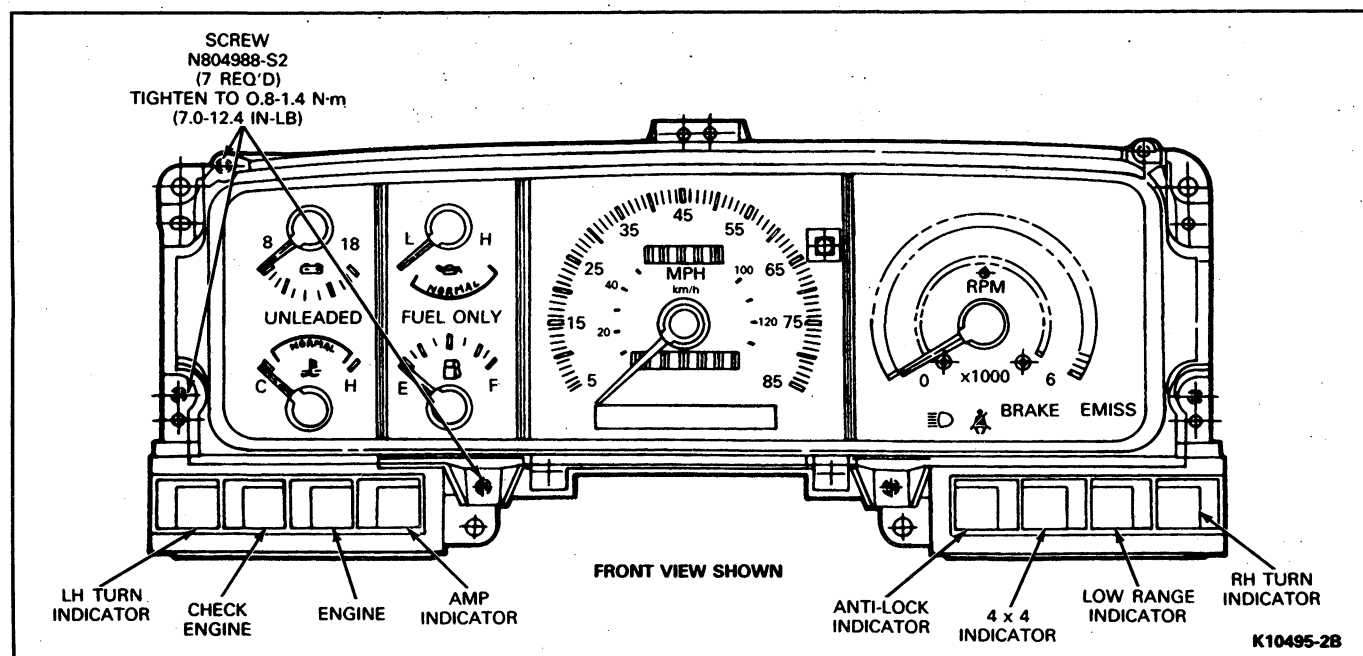


FIG. 7 Instrument Cluster—F-150—F-350, F-Super Duty and Bronco (With Tachometer)

3. Remove the six screws that retain the bezel, mask the lens to the cluster backplate and remove the mask and lens.
4. Remove the six screws retaining the four gauges and remove gauges.
5. Using a pair of needle-nose pliers remove the nine gauge terminal clips by squeezing both ends of the gauge terminal clip and push through the clip opening in the backplate. Remove lamp bulbs and print circuit.

#### Installation

1. Carefully position the printed circuit to the back of the cluster and engage it to the plastic location pins.
2. Install the gauge terminal clips and lamp bulbs.
3. Install cluster gauges and secure with screws.
4. Install the bezel, mask and lens to backplate and secure with screws.

5. Install instrument cluster assembly to instrument panel.

6. Connect the battery ground cables.

7. Check operation of all gauges and lamps.

#### Instrument Cluster Illumination and Indicator Bulbs—F-150—F-350, F-Super Duty Bronco and E-150—E-350

NOTE: Most cluster illumination and indicator bulbs can be replaced by reaching under the instrument panel. If the bulb cannot be reached from under the panel, access can be gained by removing the instrument cluster as outlined.

#### Removal and Installation

1. Turn bulb and socket one-quarter turn counterclockwise and remove.
2. Install bulb into socket.
3. Turn one-quarter turn clockwise.

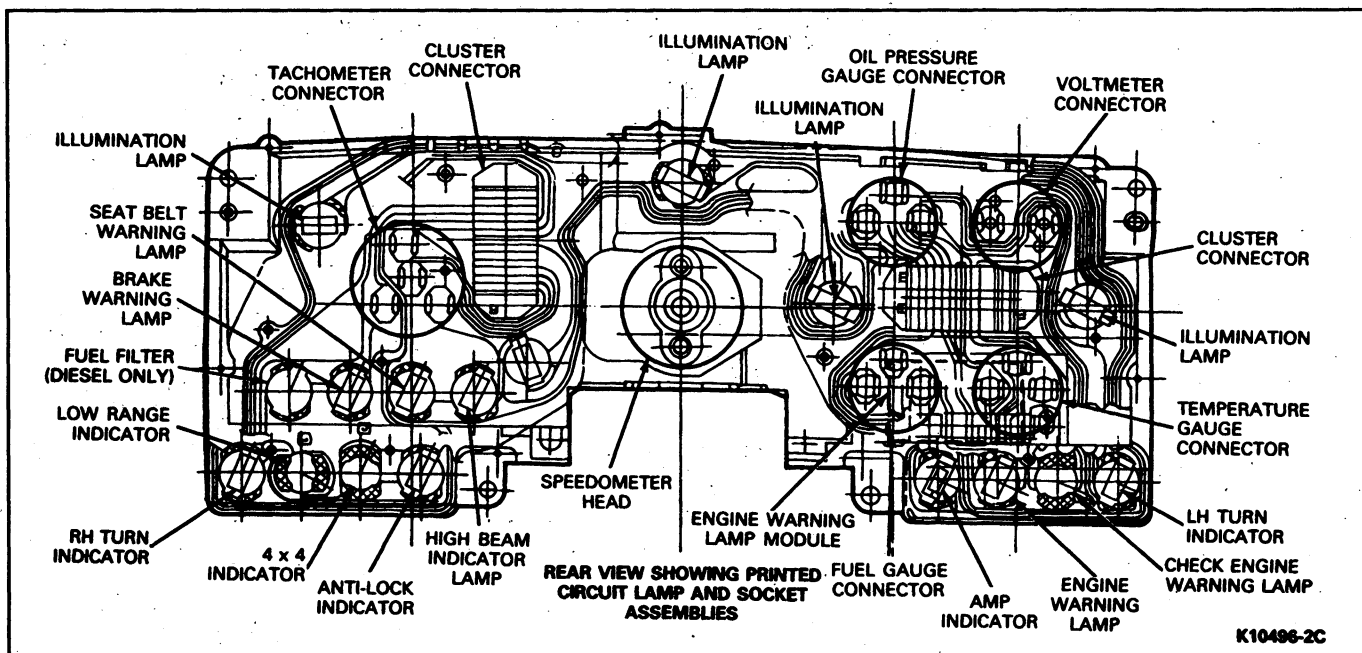
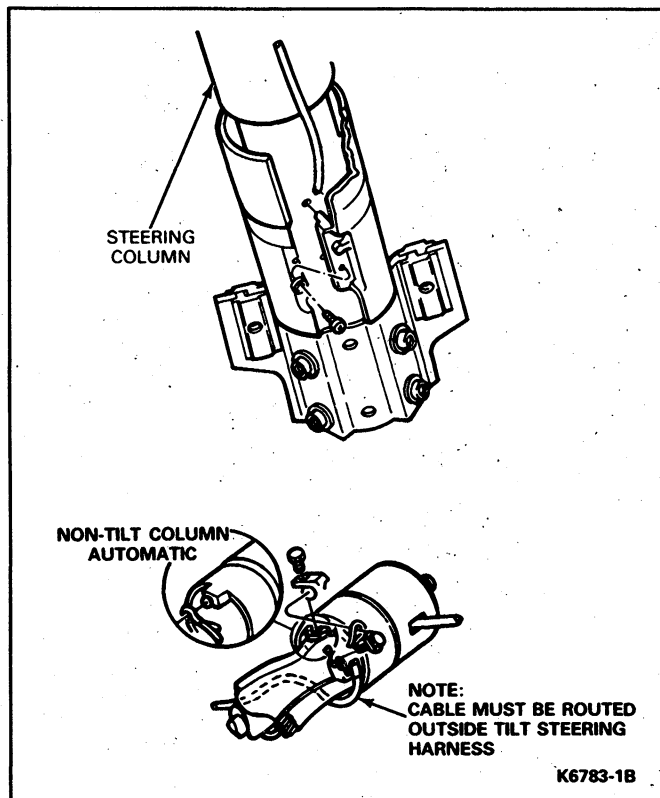
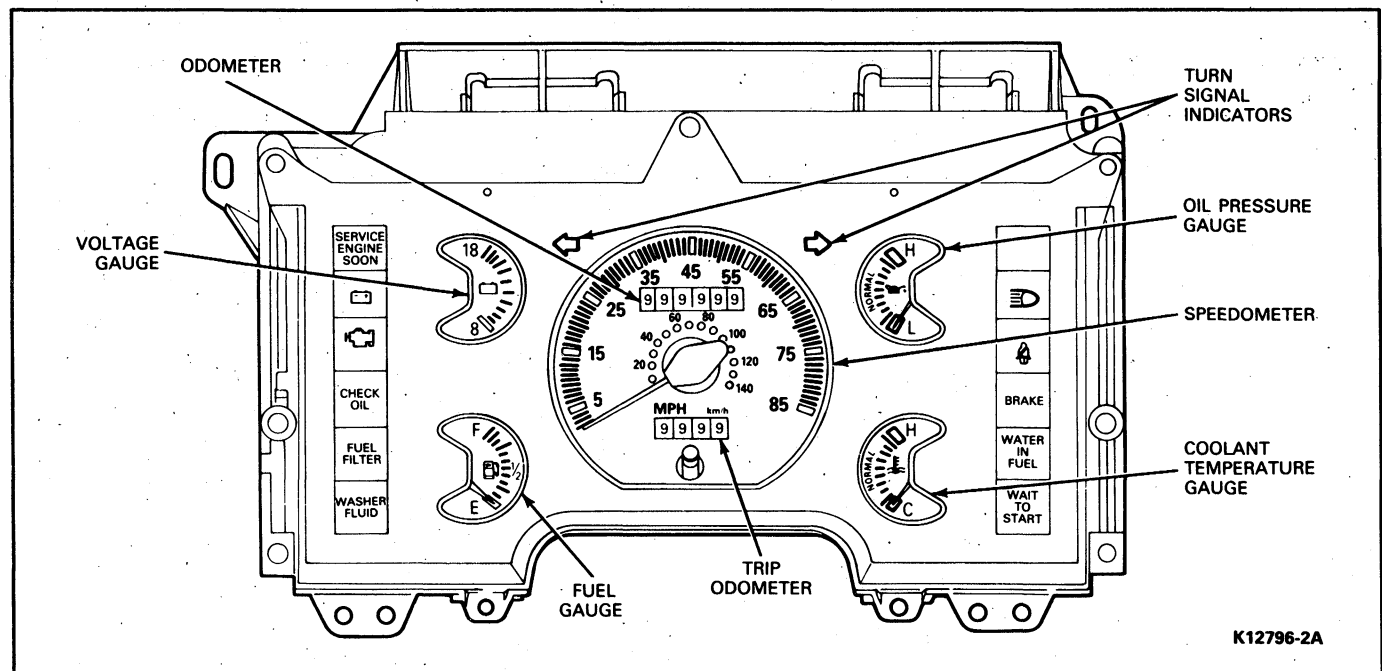


FIG. 8 Instrument Cluster Rear View—F-150—F-350, F-Super Duty and Bronco (With Tachometer)



**FIG. 9 Automatic Transmission Selector Cable Removal**



**FIG. 10 Instrument Cluster—F-Super Duty Commercial Stripped Chassis and Motor Home Chassis Vehicles**



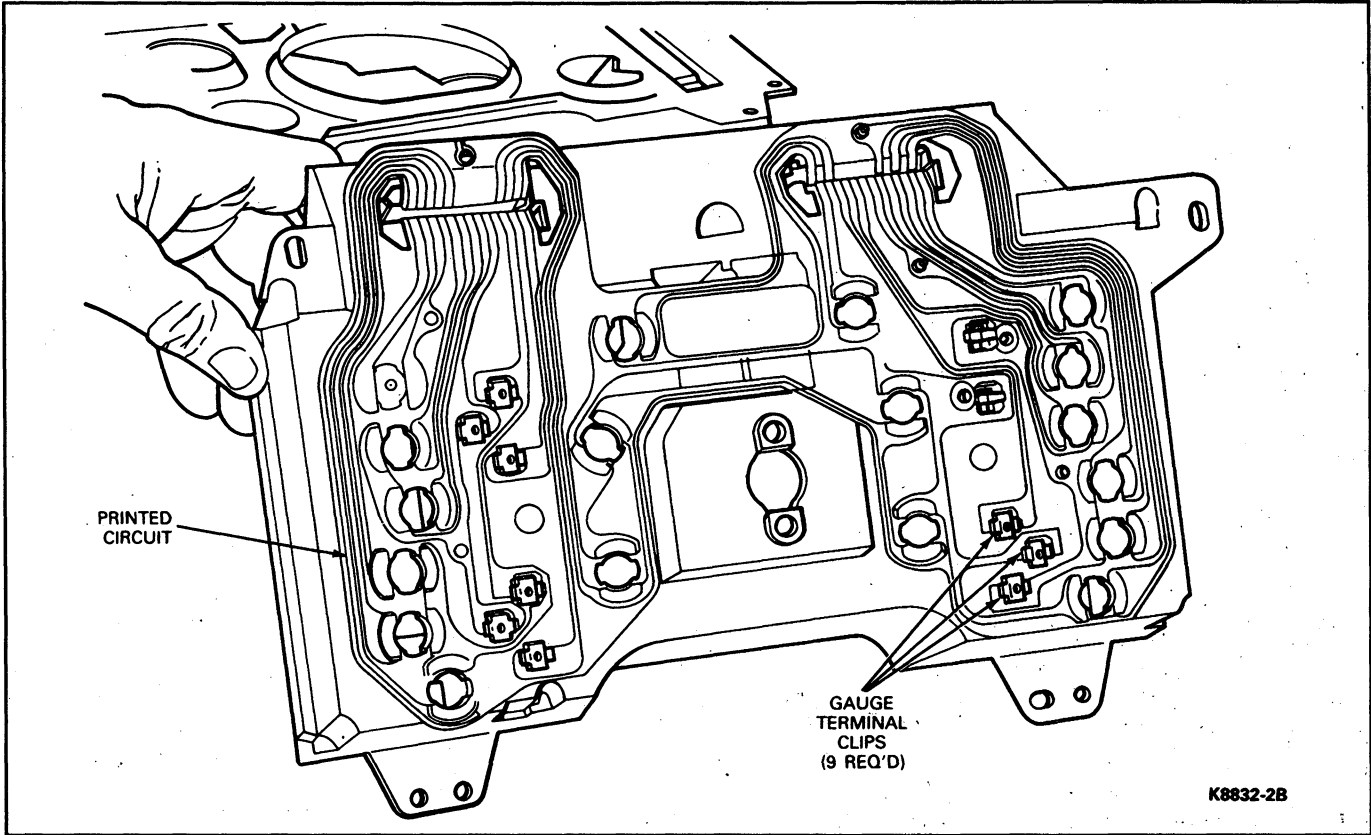


FIG. 11 Instrument Cluster Rear View—F-Super Duty Commercial Stripped Chassis and Motor Home Chassis Vehicles

SPECIAL SERVICE TOOLS

Number	Description
T74P-3504-Y	Spring Scale

CK9043-1A

# SECTION 33-71 Ignition Switch

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS .....	33-71-2	REMOVAL AND INSTALLATION .....	33-71-2
DESCRIPTION AND OPERATION .....	33-71-1	SPECIAL SERVICE TOOLS .....	33-71-3
DIAGNOSIS AND TESTING		VEHICLE APPLICATION .....	33-71-1
Electrical Test .....	33-71-1		
Mechanical Test .....	33-71-2		

## VEHICLE APPLICATION

All E-150-E350, F-150-F-350, F-Super Duty and Bronco Models.

## DESCRIPTION AND OPERATION

The switch has blade-type terminals that engage with one multiple connector (Fig. 1). The multiple connector is secured to the switch by integral locking fingers.

## DIAGNOSIS AND TESTING

NOTE: For an "engine-won't crank" condition with an automatic transmission, determine if the condition exists with the shift lever in both PARK and NEUTRAL positions before performing ignition switch continuity tests. For an "engine-won't crank" condition with a manual transmission, verify that the clutch/starter interlock switches operate properly. If the "no-crank" problem occurs in one shift lever position but not the

other, a more probable cause is the neutral start switch located on the transmission.

## Electrical Test

Disconnect the ignition switch multiple connector by spreading apart the locking fingers and pulling the plugs from the switch. Test the continuity through the switch following manufacturer's procedures for testing, or connect a self-powered test lamp or ohmmeter such as Rotunda Digital Volt Ohmmeter or equivalent, between the plug terminals indicated for each switch position in Fig. 2.

NOTE: Accessories that fail to operate with the ignition switch in the RUN position, or that remain on when the ignition switch is turned off, may be the result of a misadjusted ignition switch rather than a malfunctioning ignition switch. Refer to Adjustments.

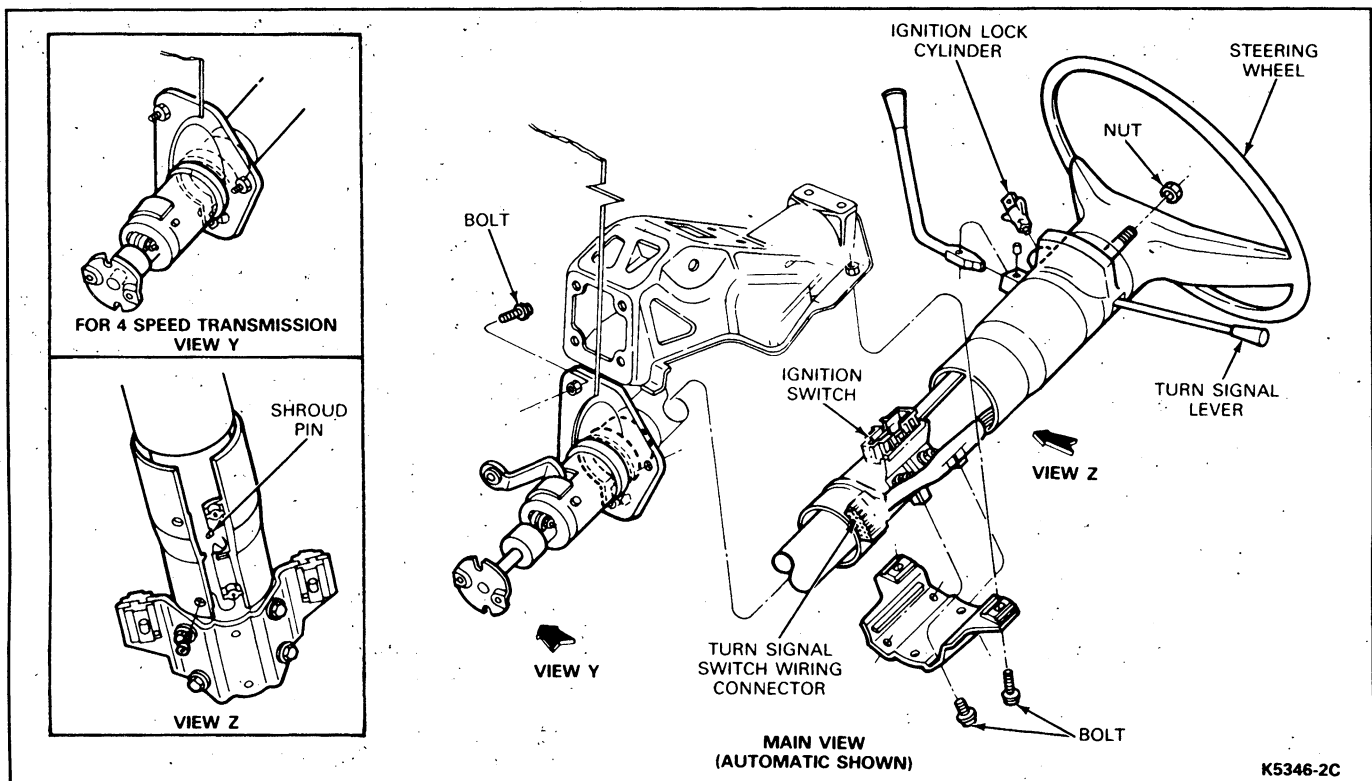


FIG. 1 Blade-Type Connector Ignition Switch

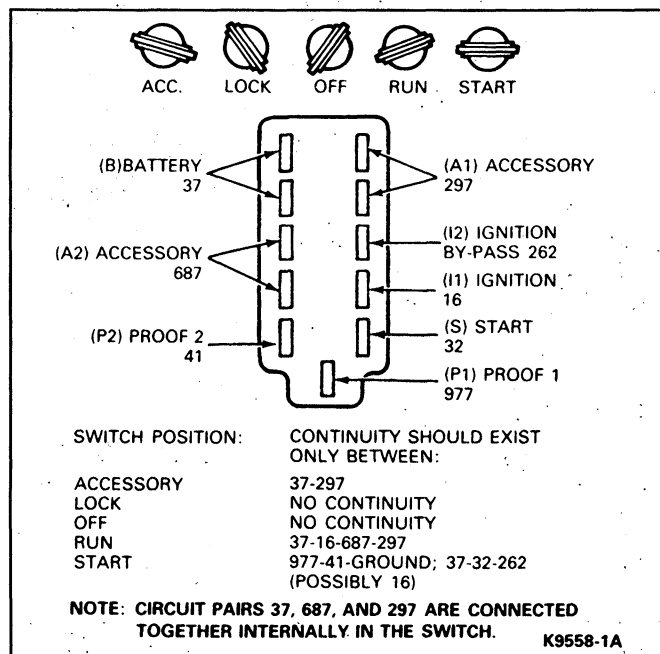


FIG. 2 Blade-Type Connector Ignition Switch Continuity Test

### Mechanical Test

Test the steering column ignition system mechanical operation by rotating the lock cylinder/key through all switch positions. The movement should not stick or bind and should return from the START position back to the RUN position without assistance (spring return). If sticking or binding is encountered, check for the following:

- Burrs on the lock cylinder key.
- Insufficient lube on lock cylinder.
- Binding lock cylinder.
- Shroud rubbing against lock cylinder.
- Burrs or foreign material around the rack and pinion actuator in the lock cylinder housing.
- Insufficient lube on actuator.
- Binding ignition switch.
- Binding actuator rod.

NOTE: DO NOT apply lubricant to the inside of the ignition switch.

### ADJUSTMENTS

1. Rotate the ignition key back and forth to either side of lock, until a 1.98mm (5/64-inch) drill bit can be inserted through the lockpin hole as far as possible (minimum 9.5mm (3/8 inch)). The lockpin hole is located on the right of the switch next to the steering column tube (Fig. 3).
2. Loosen the two ignition switch mounting nuts.
3. Turn the ignition to LOCK (feel for detent) and remove the ignition key.
4. Move the switch up and down along the column to locate the mid-position of rod lash. Tighten the two ignition switch mounting nuts (top nut first to minimize rod binding) to 4.51-7.34 N·m (40-65 in-lb).

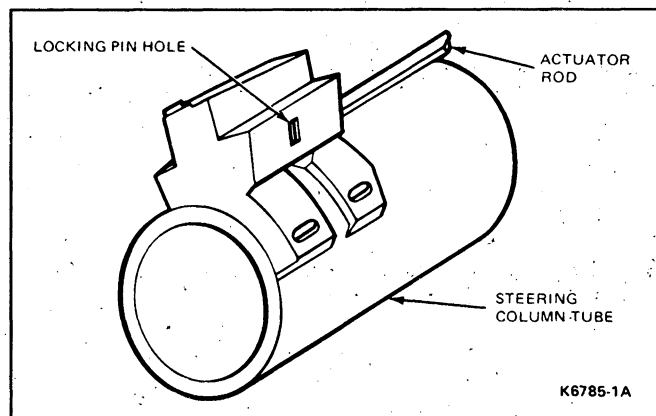


FIG. 3 Locking Pin Hole Location

5. Remove the drill bit from the ignition switch lockpin hole.
6. Plug in electrical connector and operate the lock cylinder to ensure the switch is positioned properly.
7. Confirm that all accessories are deactivated with ignition switch in OFF position, and that all accessories are operable in RUN position.

## REMOVAL AND INSTALLATION

### Removal

1. Disconnect the battery ground cable.
2. Remove steering column shroud and lower the steering column. Refer to Section 13-06, Steering Column—Shift Rod Within Tube.
3. Disconnect the switch wiring at the multiple plug.
4. Remove the two nuts that retain the switch to the steering column.
5. Lift the switch vertically upward to disengage the actuator rod from the switch and remove switch.

### Installation

1. When installing the ignition switch, both the locking mechanism at the top of the column and the switch itself must be in LOCK position for correct adjustment.

To hold the mechanical parts of the column in LOCK position, move the shift lever into PARK (with automatic transmissions) or REVERSE (with manual transmissions), turn the key to LOCK position, and remove the key. New replacement switches, when received, are already pinned in LOCK position by a metal shipping pin inserted in a locking hole on the side of the switch.

2. Engage the actuator rod in the switch. Must be inserted in the slot of the sliding, black carrier.
3. Position the switch on the column and install the retaining nuts, but do not tighten them.
4. Move the switch up and down along the column to locate the mid-position of rod lash. Tighten the two ignition switch retaining nuts (top nut first to minimize rod binding) to 4.51-7.34 N·m (40-65 in-lb).
5. Remove the lockpin. Connect the battery cable, and check for proper start in PARK or NEUTRAL.

Also, ensure the start circuit cannot be actuated in the DRIVE and REVERSE position.

6. Raise the steering column into position at instrument panel. Refer to Section 13-06, Steering Column—Shift Rod Within Tube. Install steering column shroud.
7. Confirm that accessories are deactivated with ignition switch in OFF position, and that accessories are operable with switch in RUN position.

**SPECIAL SERVICE TOOLS**

Number	Description
007-00001	Digital Volt Ohmmeter

CK12708-1A

# **MAIN WIRING HARNESS CIRCUIT PROTECTION AND CONNECTORS**

## **GROUP 34**

(14000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
CONNECTOR DISENGAGEMENT .....	34-01-1	WIRING LIGHT TRUCK .....	34-02-1
FUSES, CIRCUIT BREAKERS AND FUSE LINKS .....	34-31-1		

## SECTION 34-01 Connector Disengagement

SUBJECT	PAGE	SUBJECT	PAGE
ALL MODEL APPLICATIONS .....	34-01-1	VEHICLE APPLICATION .....	34-01-1

### VEHICLE APPLICATION

All Models.

### ALL MODEL APPLICATIONS

Connector disengagement procedures are shown in Figs. 1 through 4 and should be used when disconnecting the various types of connectors.

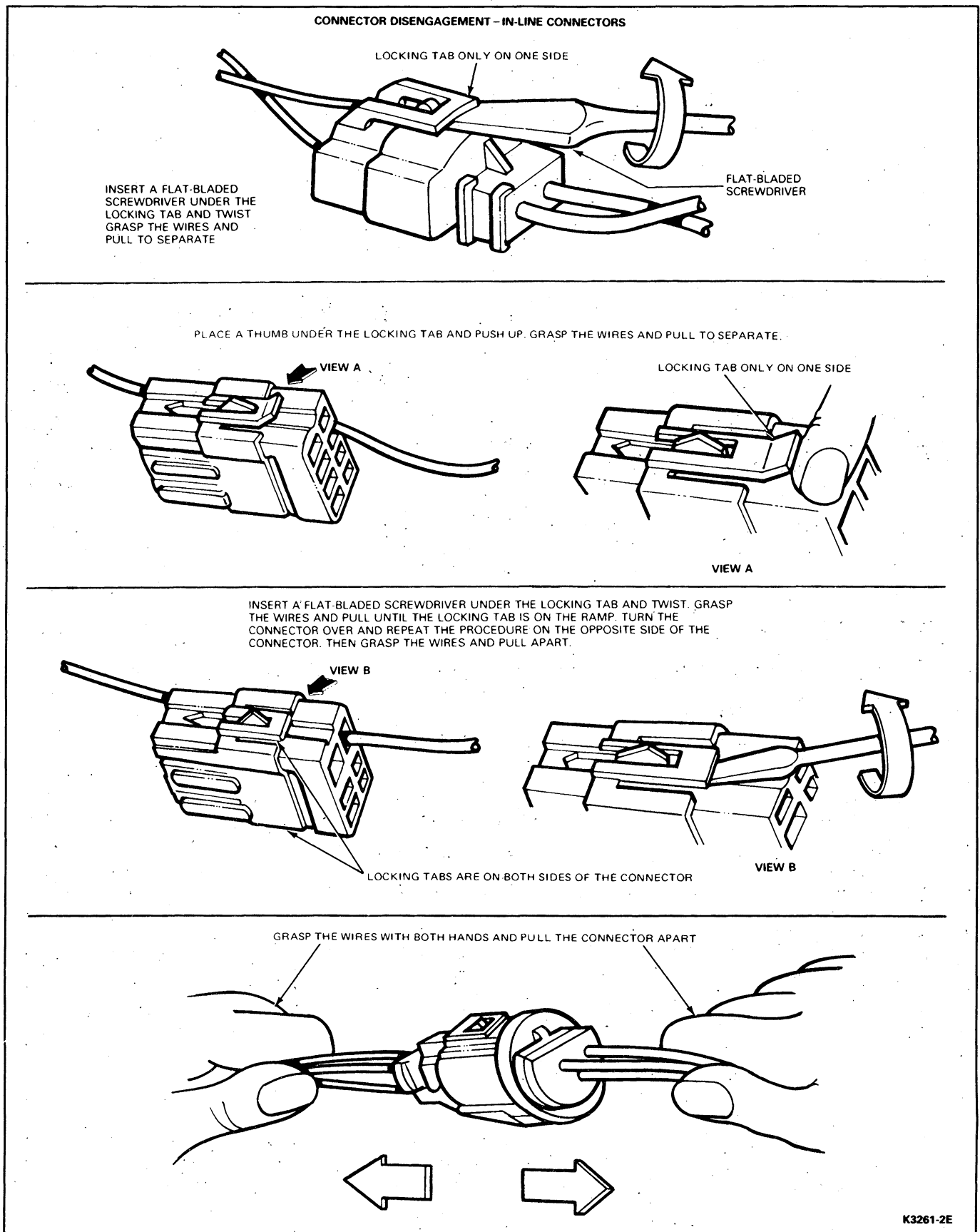
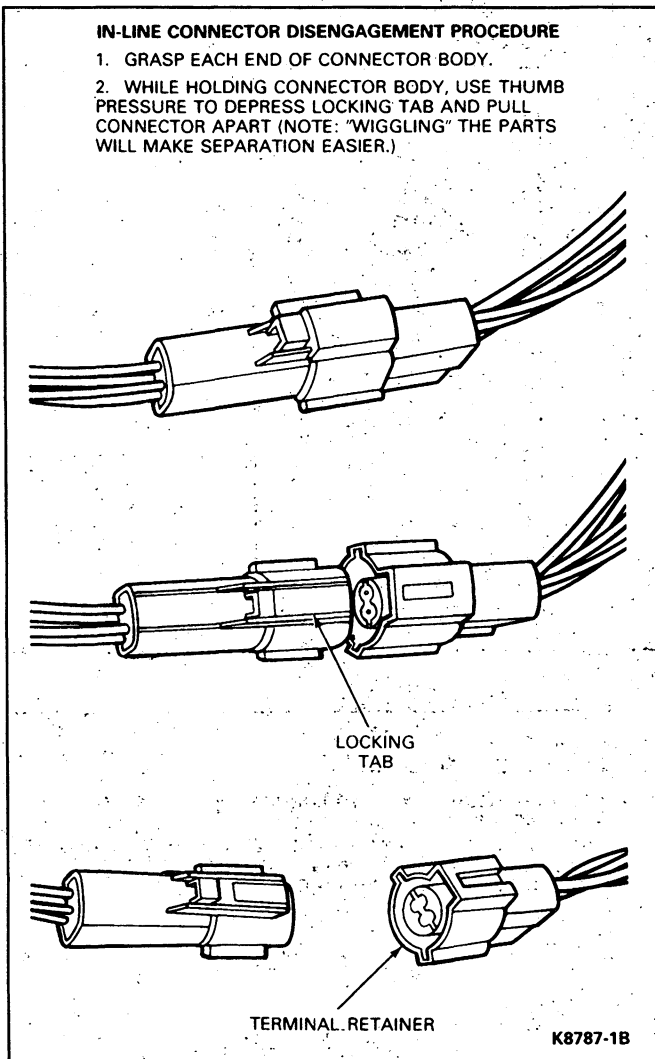


FIG. 1 Connector Disengagement—In-line Connectors



**FIG. 2 Connector Disengagement—In-line Connectors (continued)**

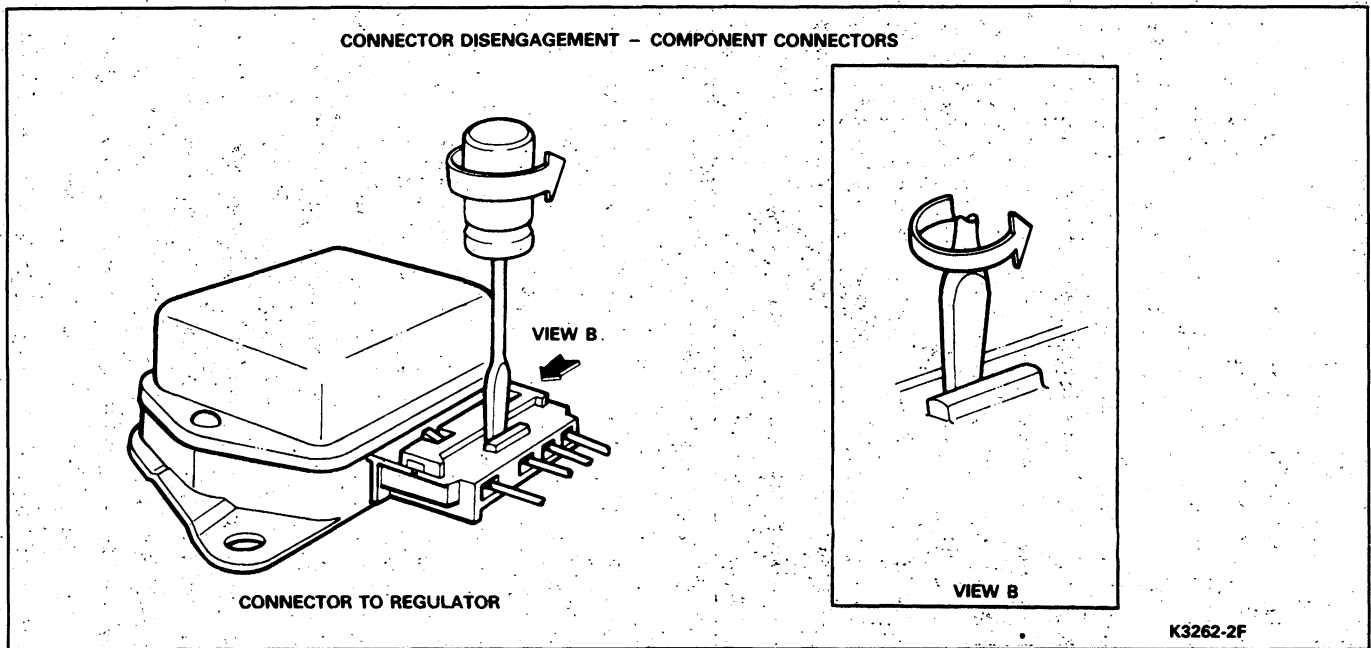


FIG. 3 Connector Disengagement—Component Connectors

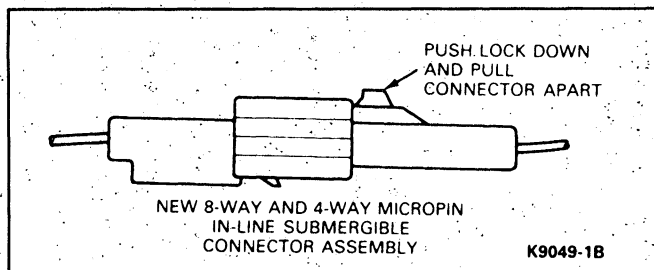


FIG. 4 Connector Disengagement—In-line Submersible Connector

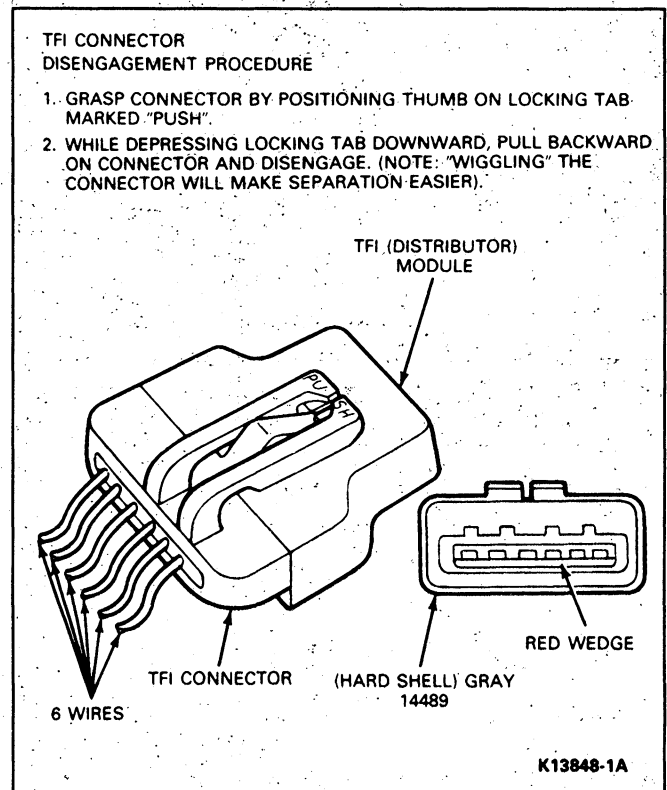


FIG. 5 Connector Disengagement—TFI Connector



## SECTION 34-02 Wiring Light Truck

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION .....	34-02-1	VEHICLE APPLICATION .....	34-02-1

### VEHICLE APPLICATION

E-150 through E-350, F-150 through F-350, F-Super Duty and Bronco.

### REMOVAL AND INSTALLATION

The illustrations in this Section show the complete wiring harness installation for Light Truck vehicles. Refer to the illustrations for the applicable harness while performing Removal and Installation procedures.

#### Removal

1. Disconnect battery ground cable.  
NOTE: Refer to Group 45 if it is necessary to remove any trim panels to gain access to the harness.
2. Disconnect all wiring harness connectors.
3. Disengage harness from all locators, straps and/or clips as necessary, including ground wire eyelets. Remove harness from vehicle.

#### Installation

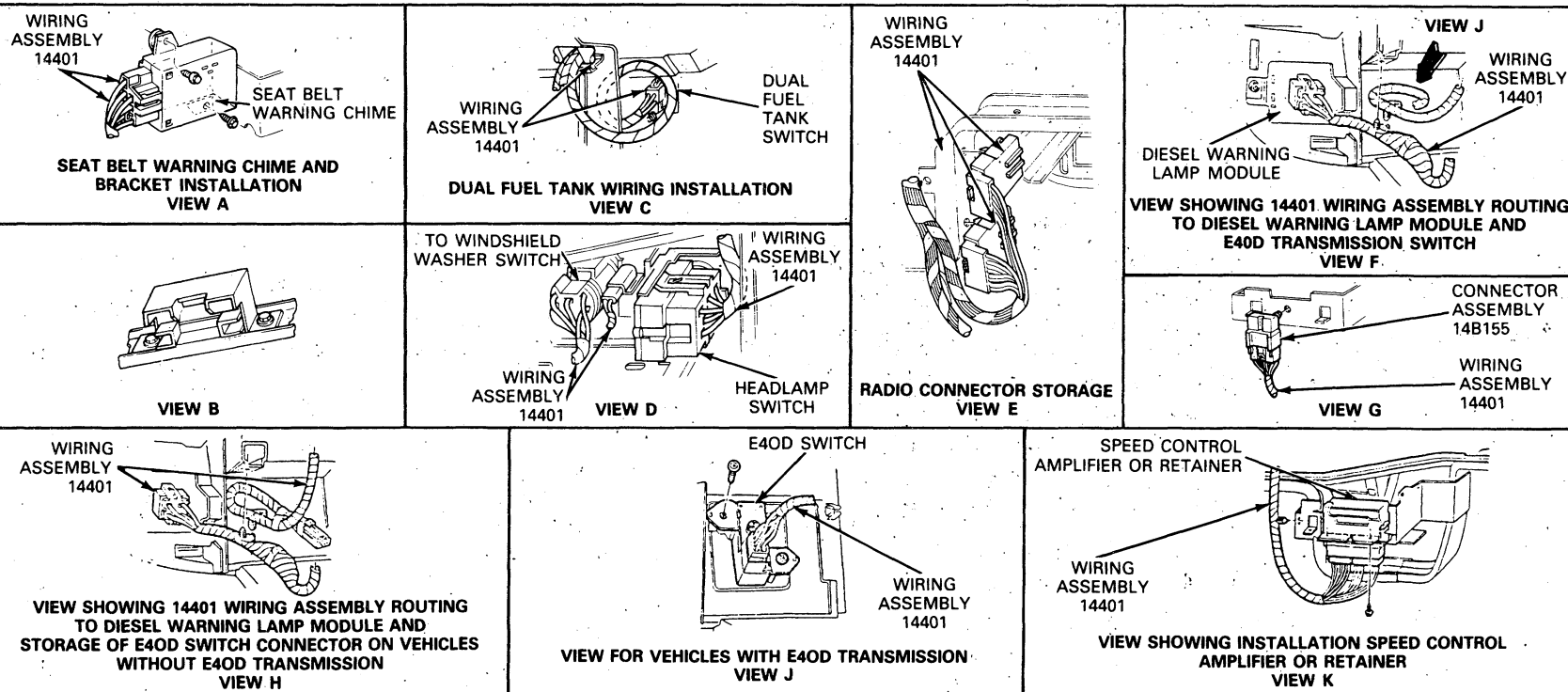
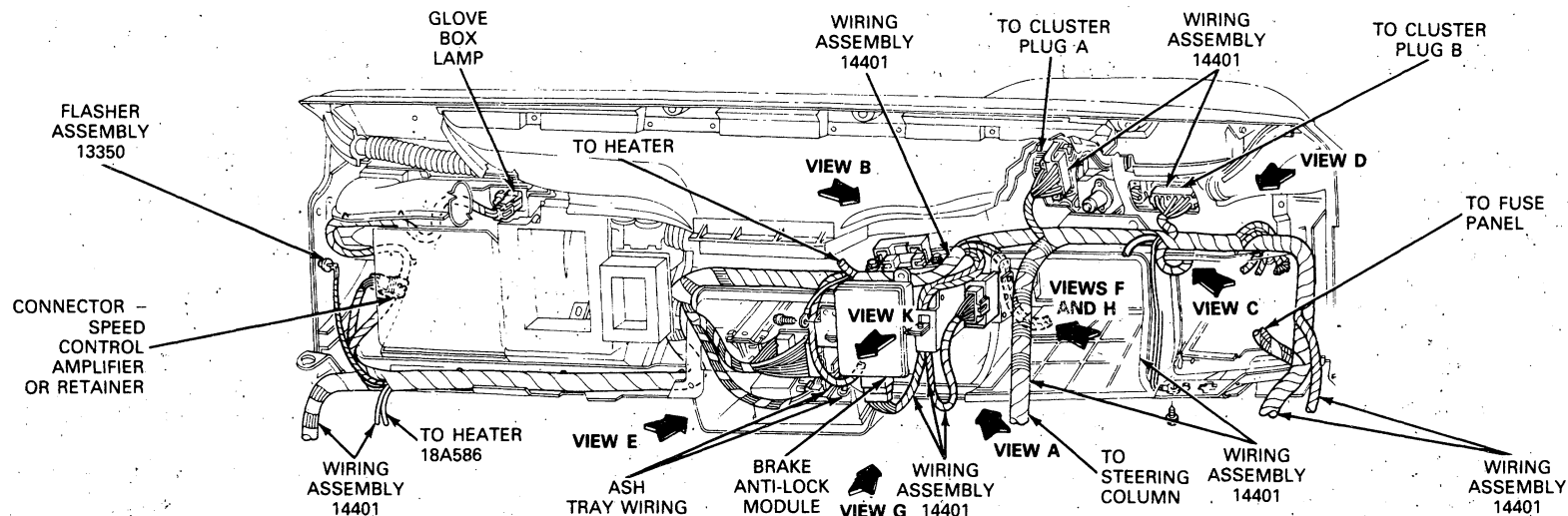
1. Position harness in vehicle. Ensure that harness is engaged in all locators, straps and/or clips.
2. Connect all harness connectors to components or other harnesses as necessary.
3. Secure ground eyelets to body as necessary.
4. Connect battery ground cable. Check all applicable circuits for proper operation.
5. Install any trim removed during harness removal. Refer to Group 45.

## Instrument Panel Wiring Installation—F-150—F-350, F-Super Duty and Bronco (Gas Engines)



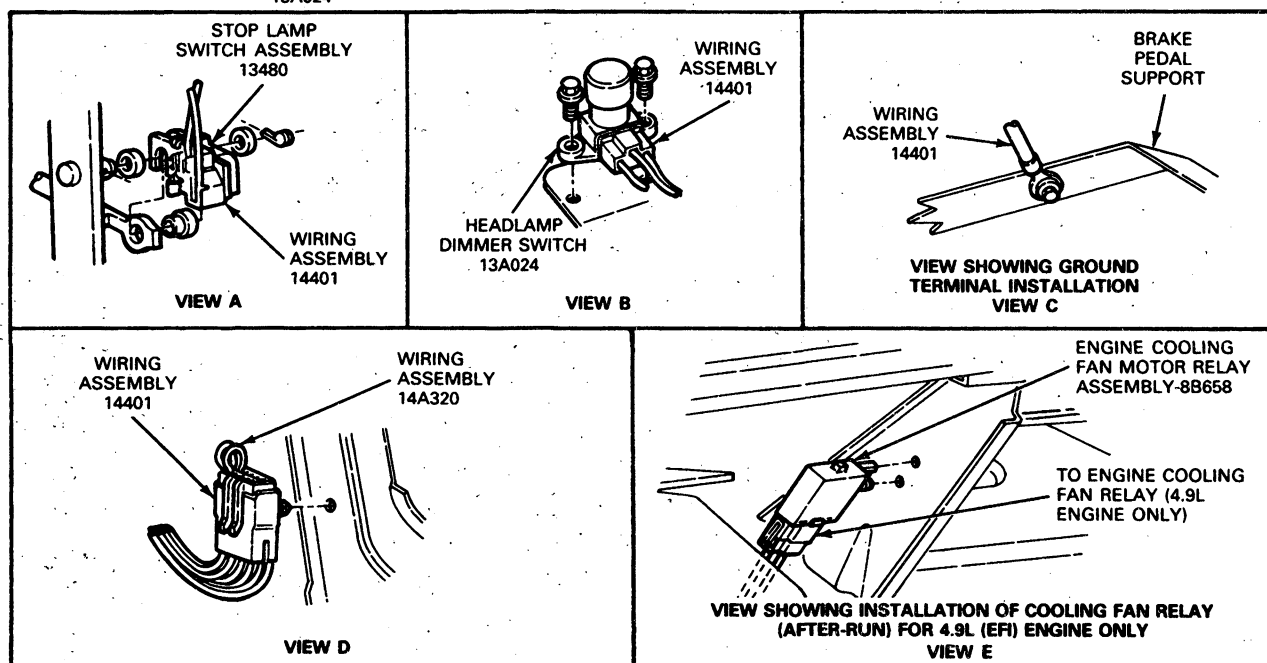
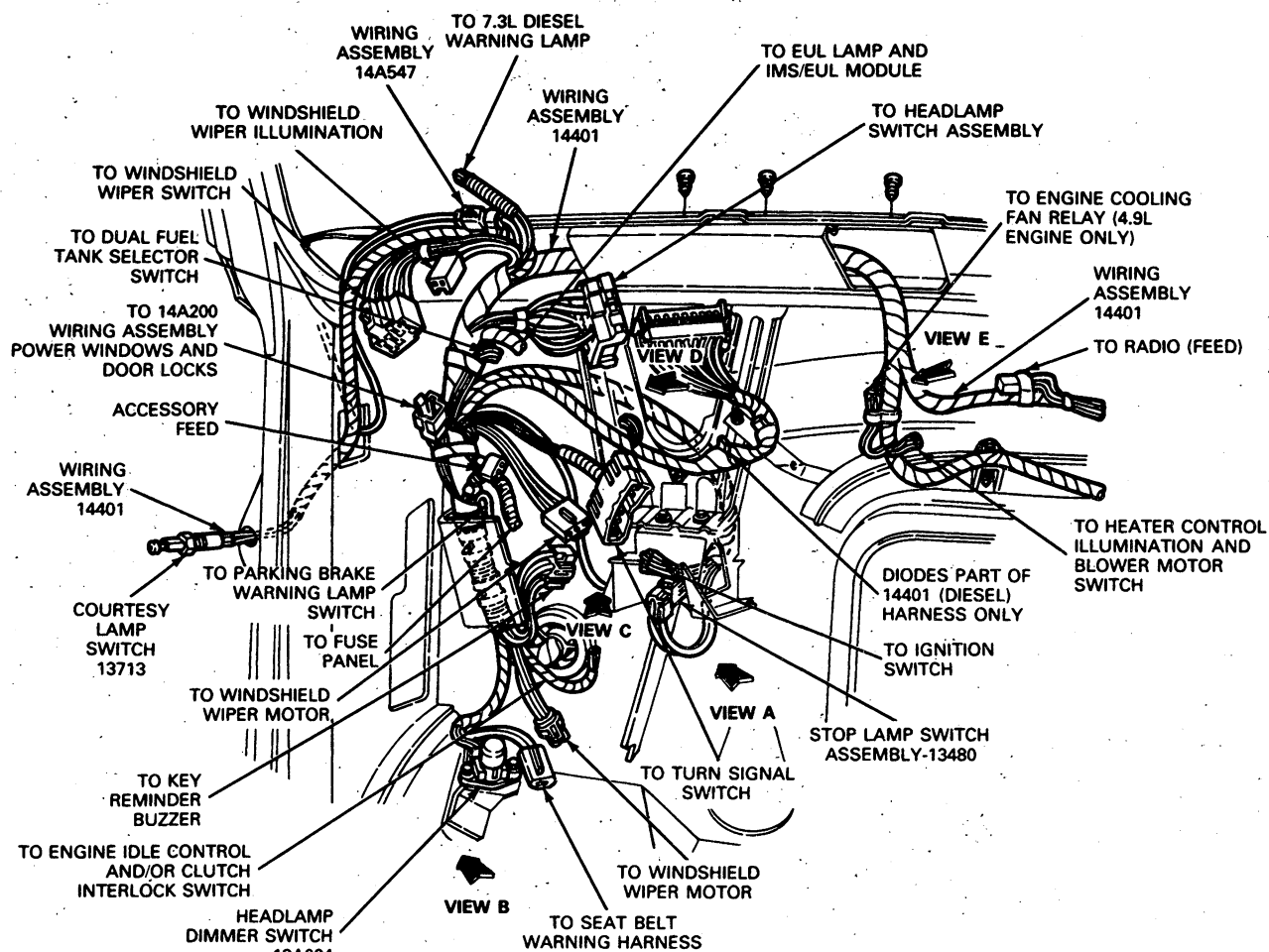
# **REMOVAL AND INSTALLATION (Continued)**

**Instrument Panel Wiring Installation—F-150—  
F-350, F-Super Duty (Diesel Engine)**

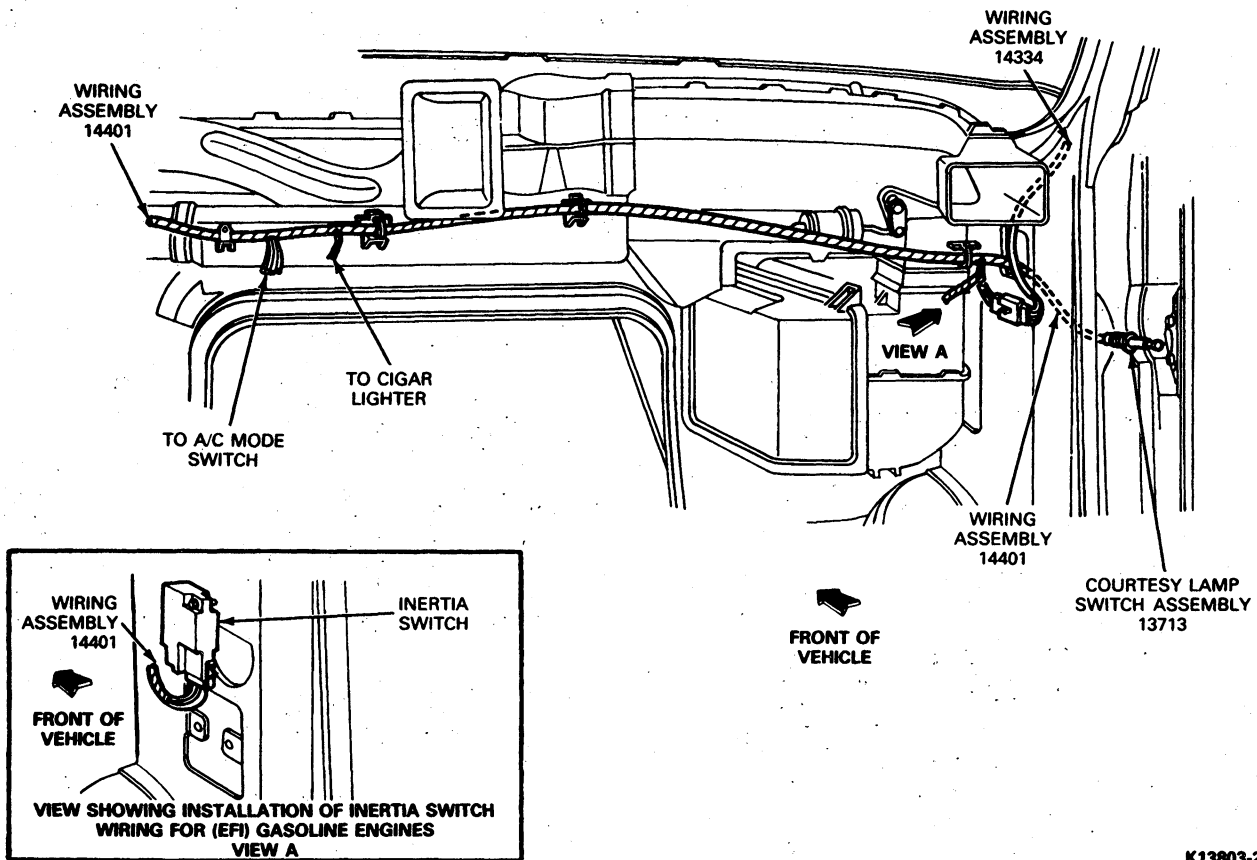


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## REMOVAL AND INSTALLATION (Continued)

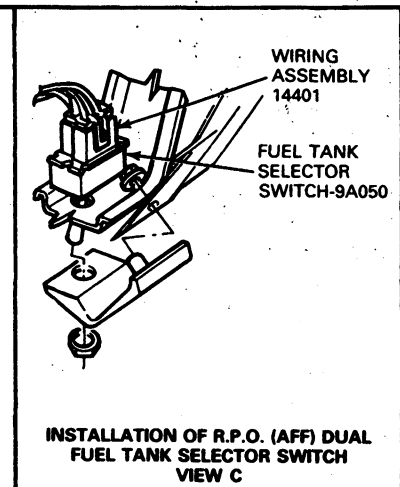
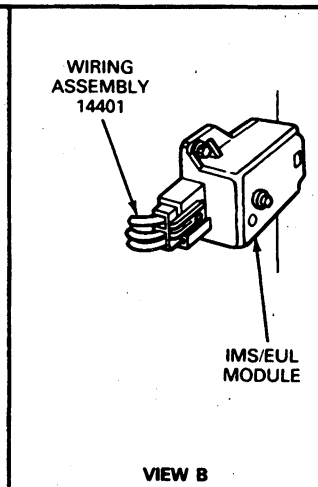
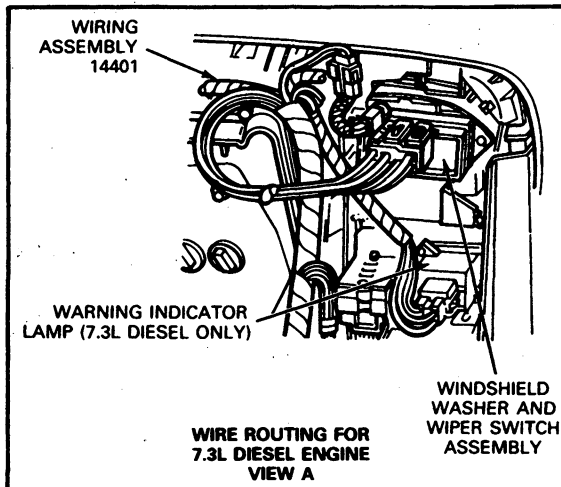
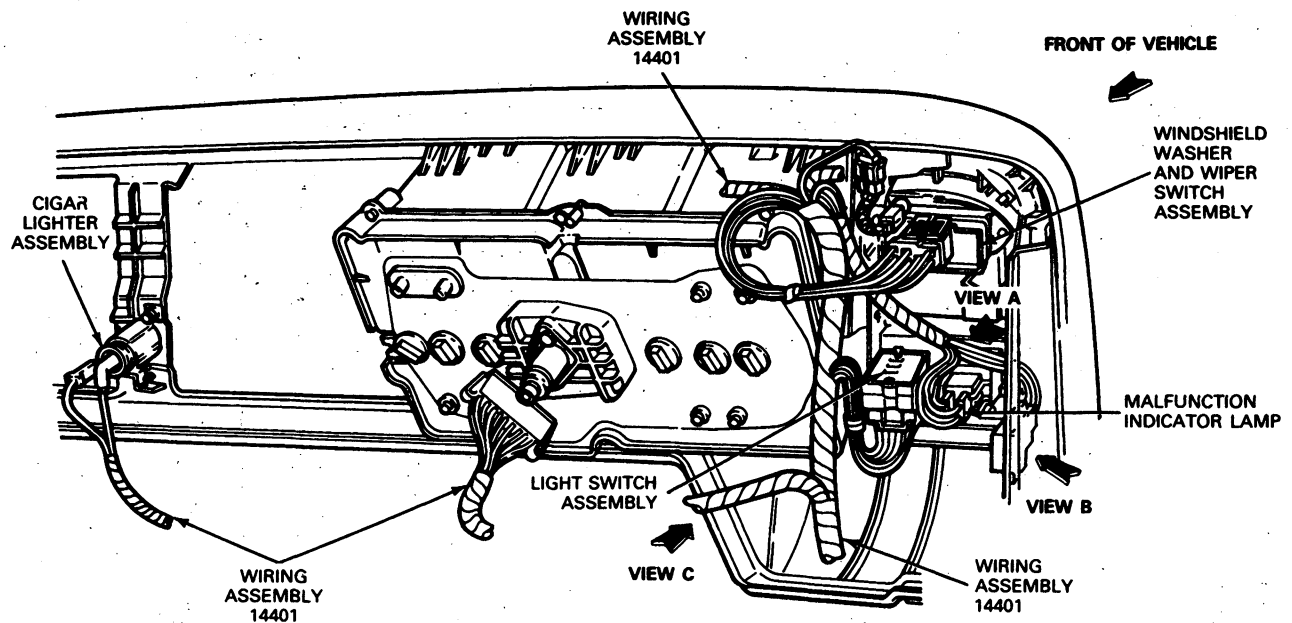
Instrument Panel Wiring Installation—E-Series  
LH Side

K13802-2A

**REMOVAL AND INSTALLATION (Continued)****Instrument Panel Wiring Installation—  
E-Series—RH Side**

K13803-2A

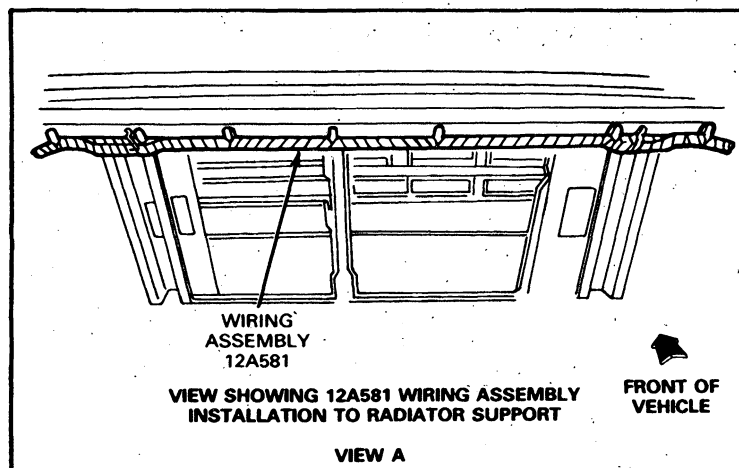
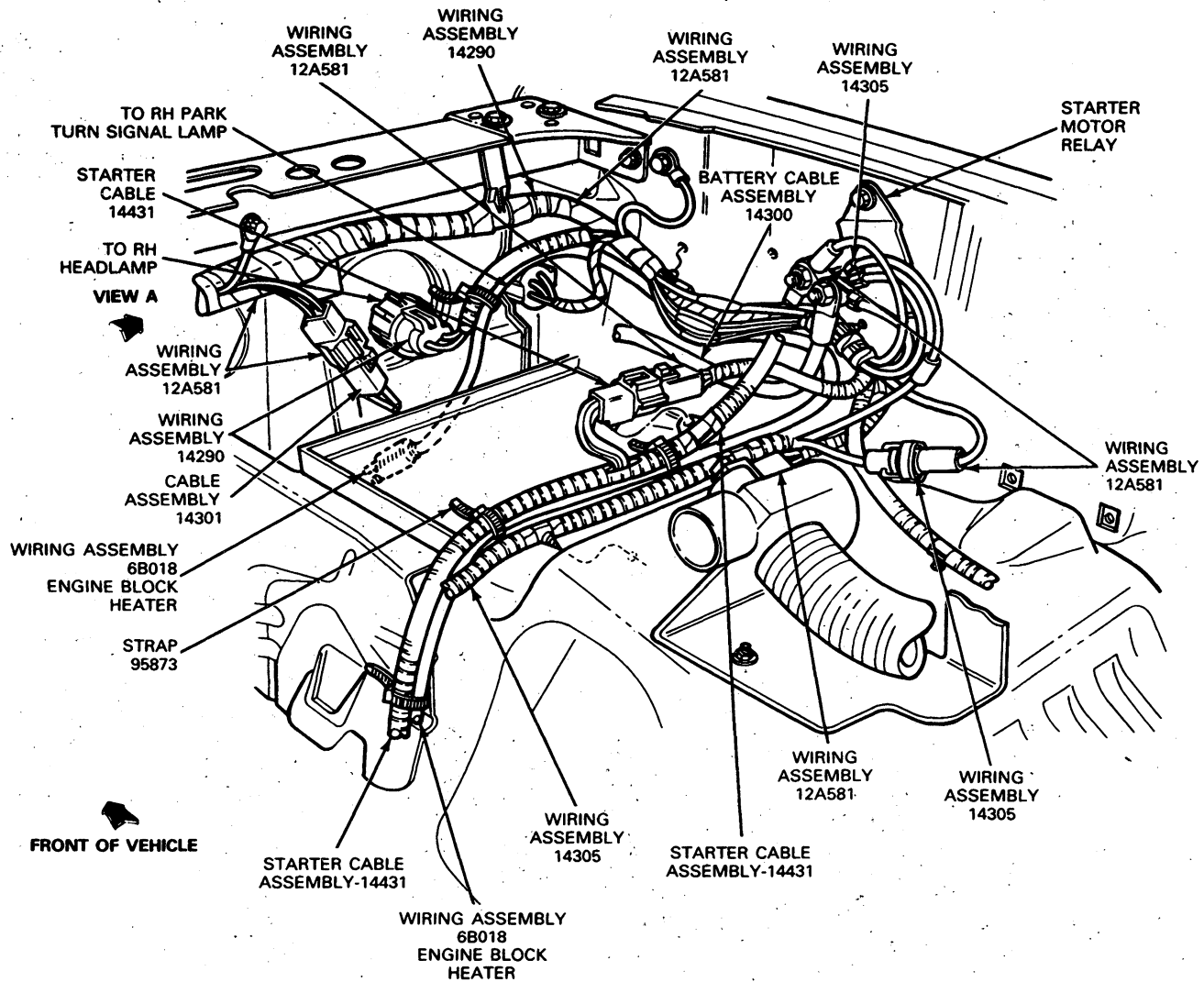
## REMOVAL AND INSTALLATION (Continued)

Instrument Panel and Dual Fuel Tank Wiring  
Installation—E-Series

K13804-2A

## REMOVAL AND INSTALLATION (Continued)

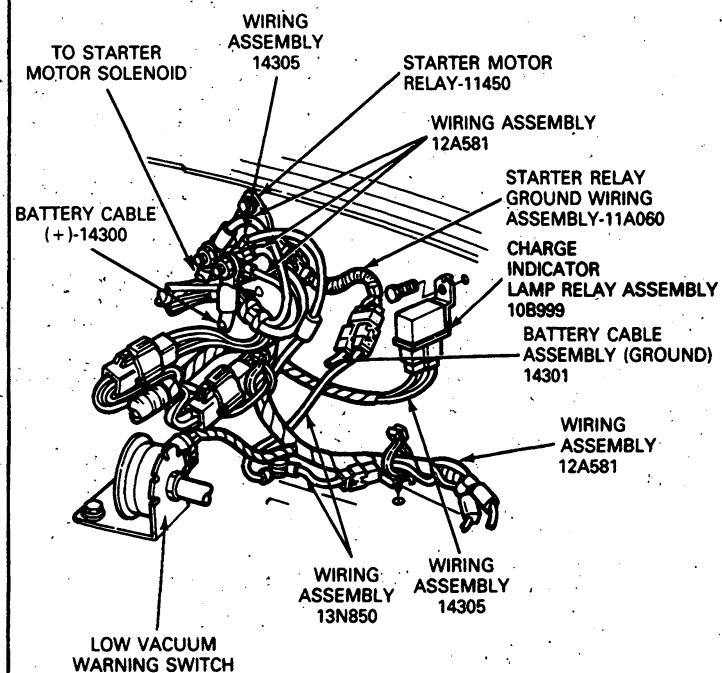
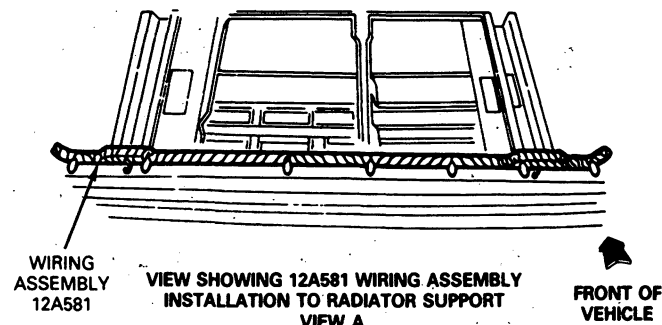
Fender Apron, RH—F-150—F-350, F-Super  
Duty and Bronco with 4.9L, 5.0L, 5.8L and 7.5L  
EFI Engines



K10541-2B

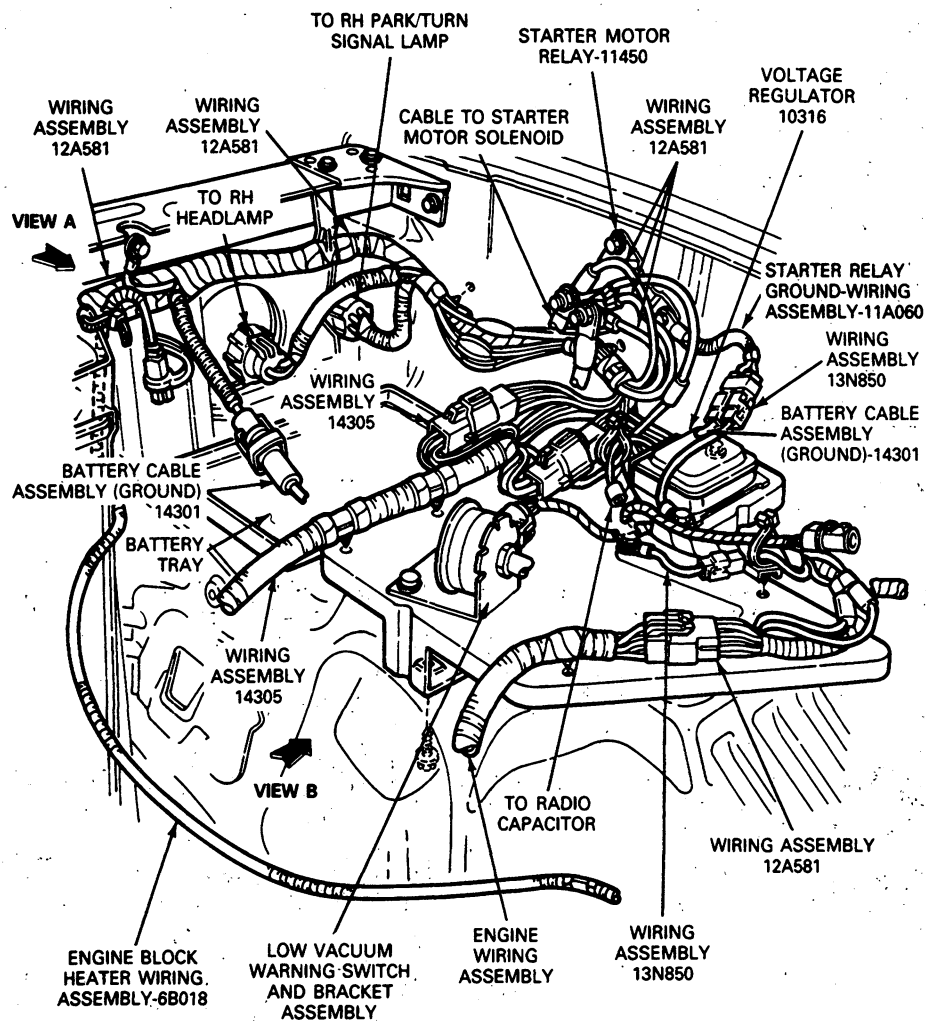
# REMOVAL AND INSTALLATION (Continued)

Fender Apron, RH—F-150—F-350, F-Super  
Duty and Bronco with 7.3L Diesel Engine



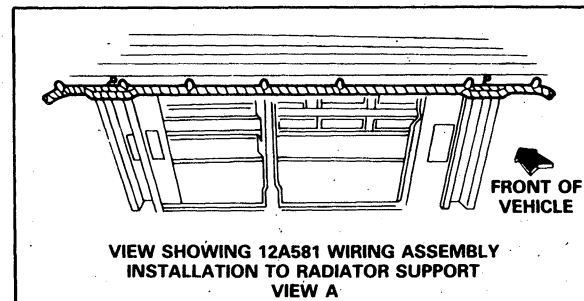
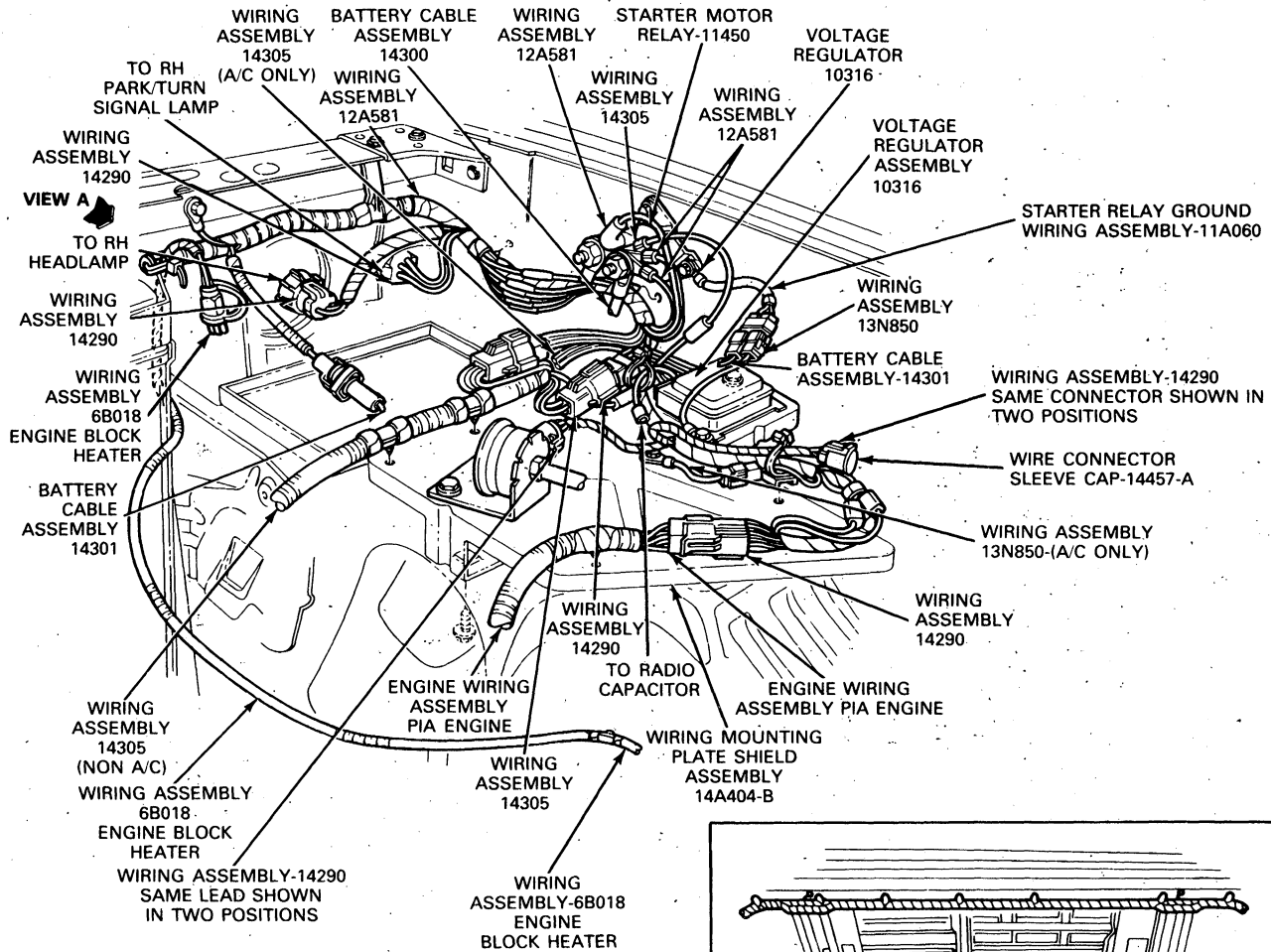
VIEW SHOWING 14305 WIRING INSTALLATION FOR  
R.P.O. (F8S) AMBULANCE PREP. PACKAGE  
VIEW B

K13805-2A





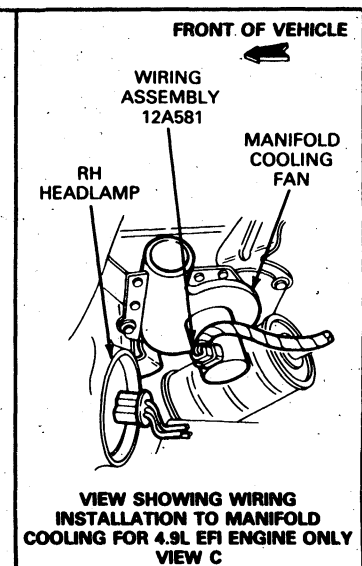
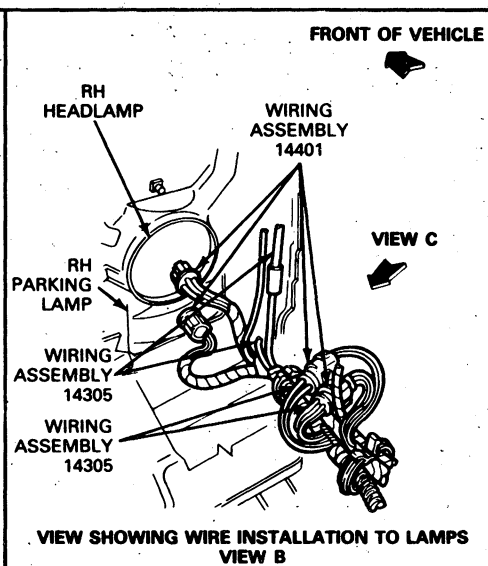
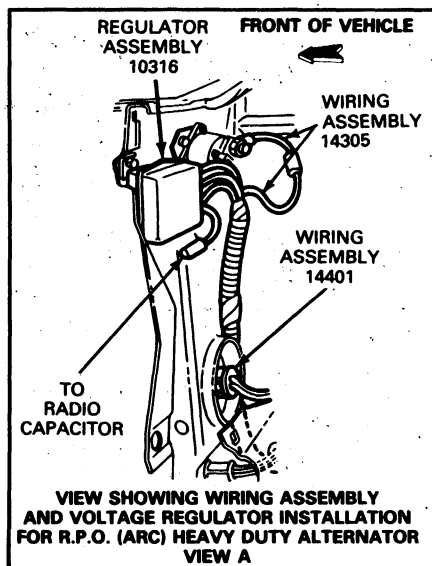
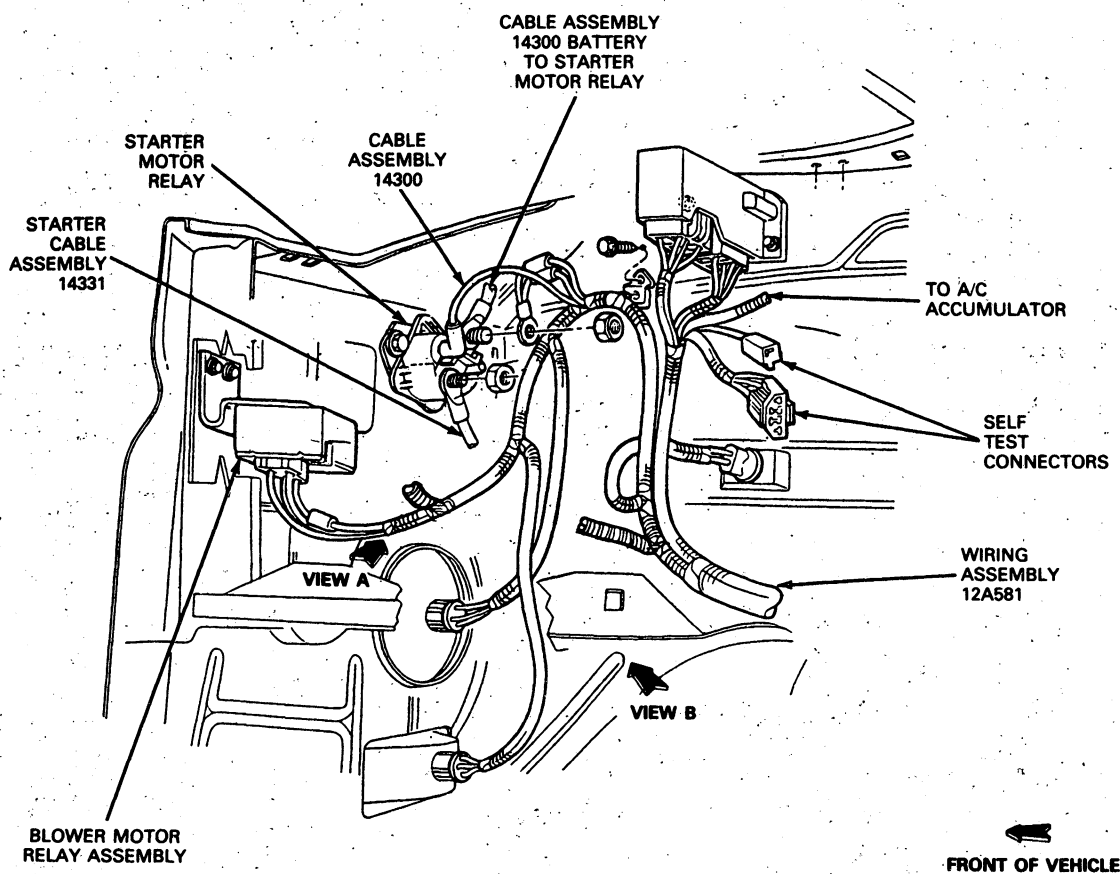
## REMOVAL AND INSTALLATION (Continued)

Fender Apron, RH—F-250—F-350 and F-Super  
Duty with 7.3L Diesel Engine

K10545-2B

## REMOVAL AND INSTALLATION (Continued)

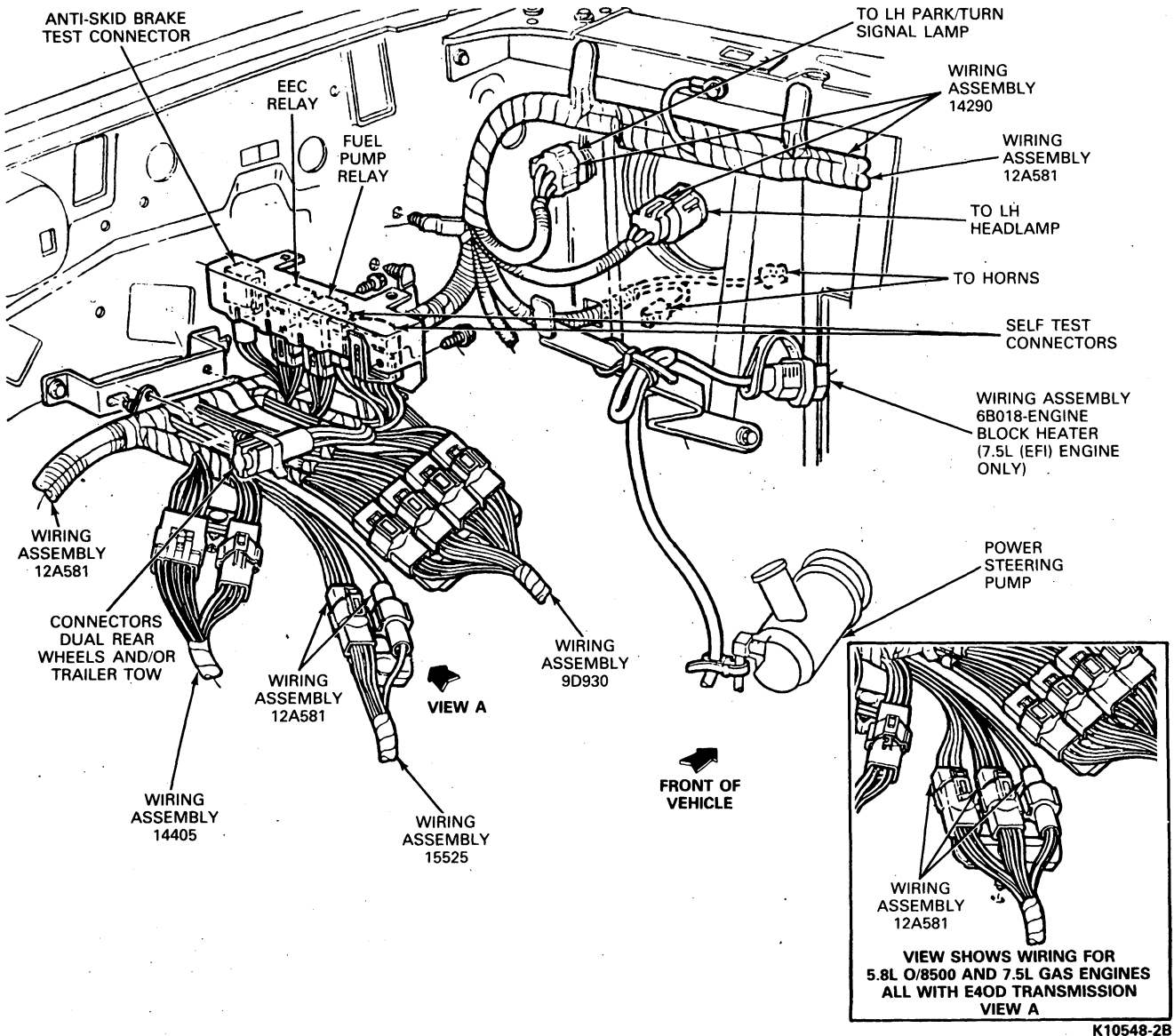
## Fender Apron, RH—E-Series with Gasoline Engines



K11964-2B

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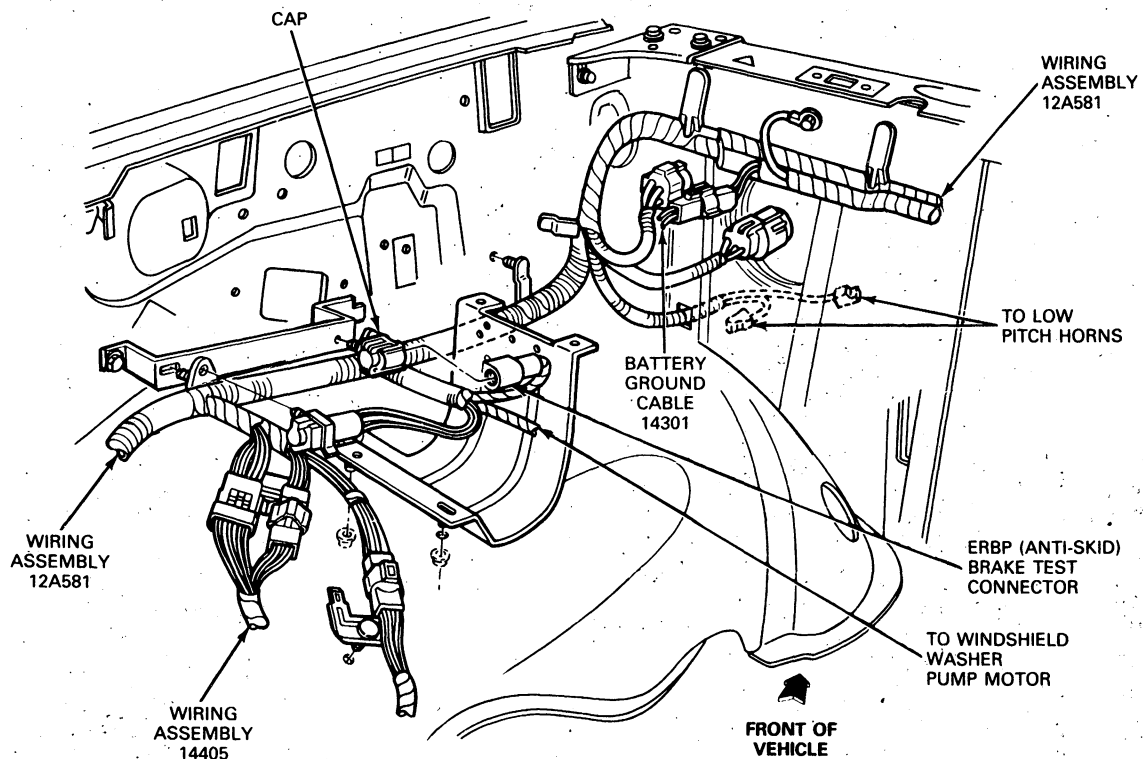
**Fender Apron, LH—F-150—F-350, F-Super Duty and Bronco with 4.9L, 5.0L, 5.8L and 7.5L (EFI) Engines**



K10548-2B

## REMOVAL AND INSTALLATION (Continued)

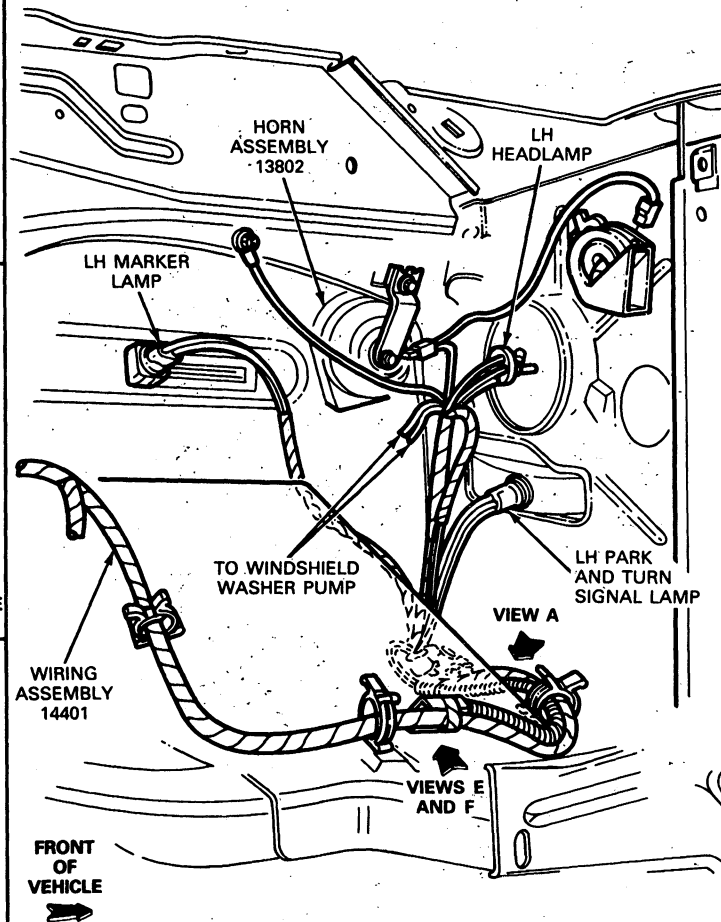
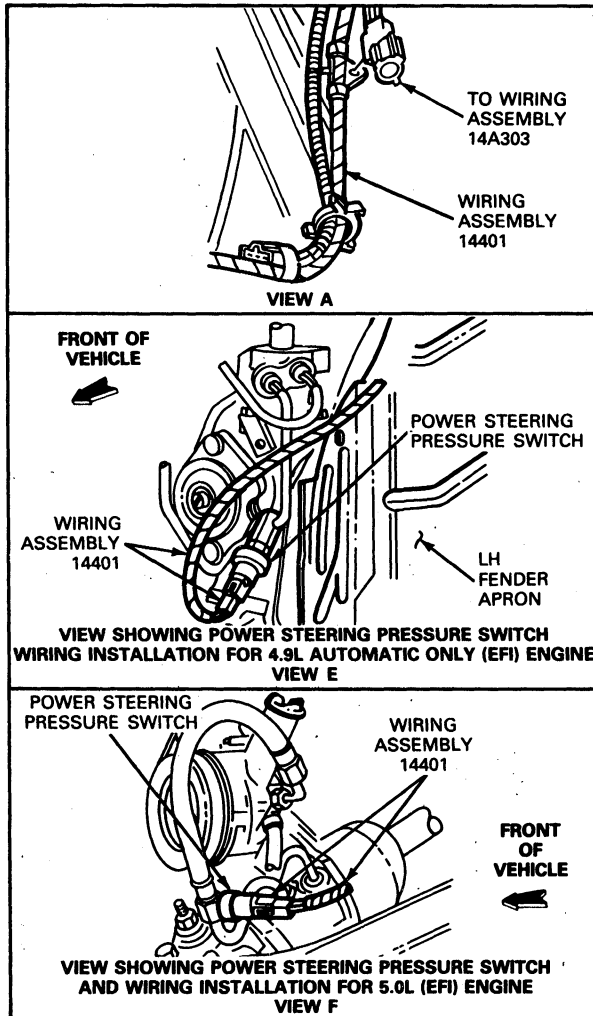
Fender Apron, LH—F-150—F-350, F-Super  
Duty and Bronco with 7.3L Diesel Engine



K10550-2B

## REMOVAL AND INSTALLATION (Continued)

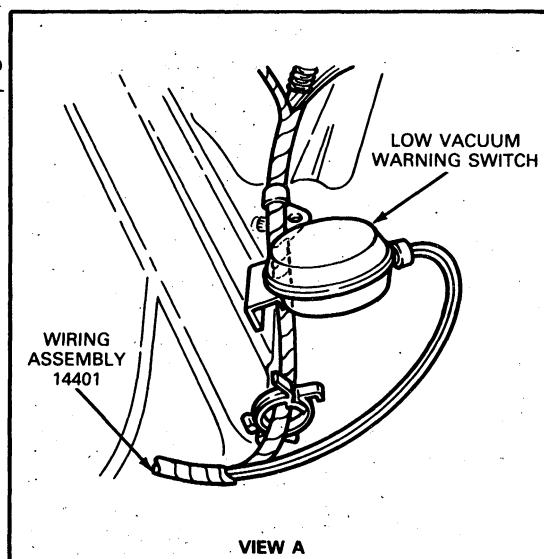
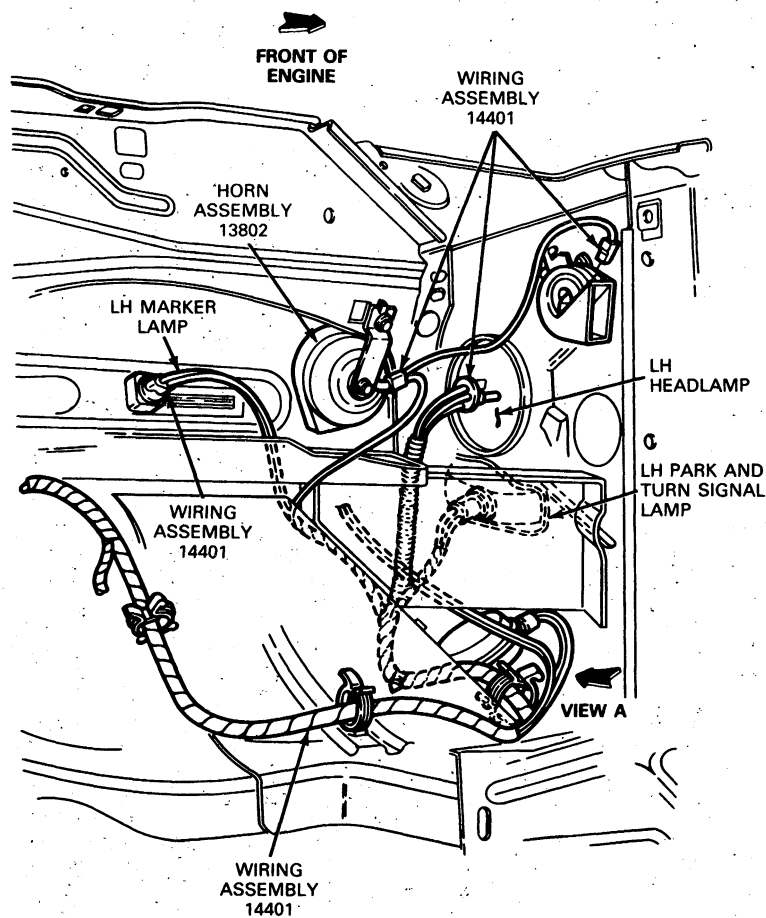
## Fender Apron, LH—E-Series with Gasoline Engines



K11966-2A

## REMOVAL AND INSTALLATION (Continued)

## Fender Apron, LH—E-Series with 7.3L Diesel Engine

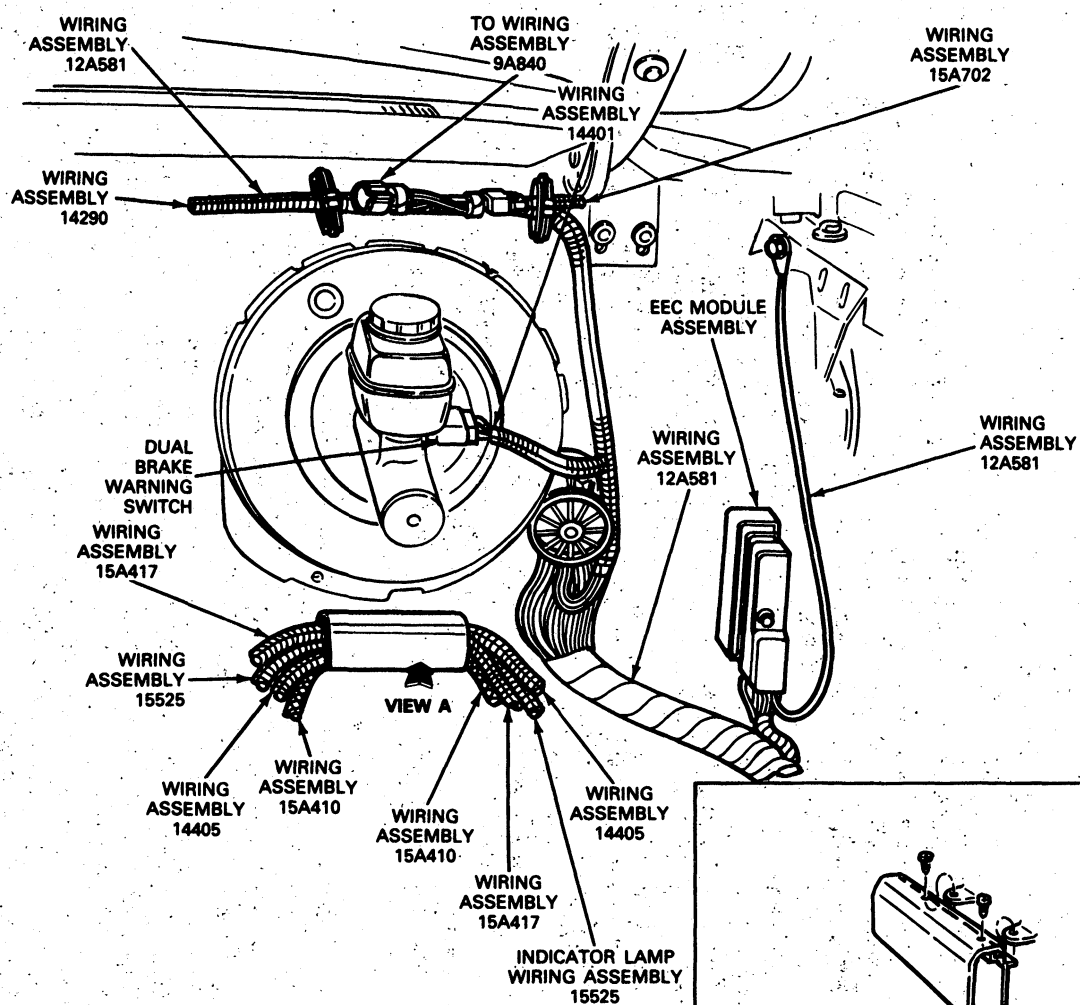


K11967-2A



## REMOVAL AND INSTALLATION (Continued)

### Dash Panel Wiring—F-Series with 7.3L Diesel Engine without E4OD Transmission

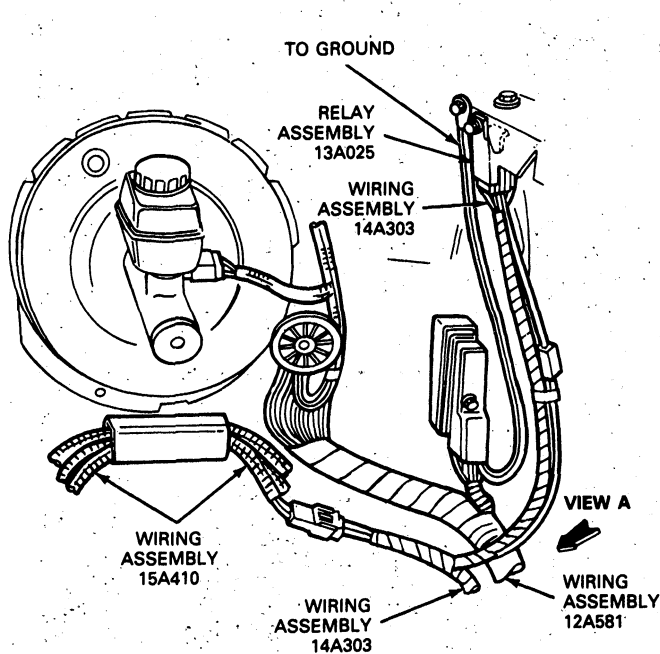


**14A163 RETAINER INSTALLATION  
VIEW A**

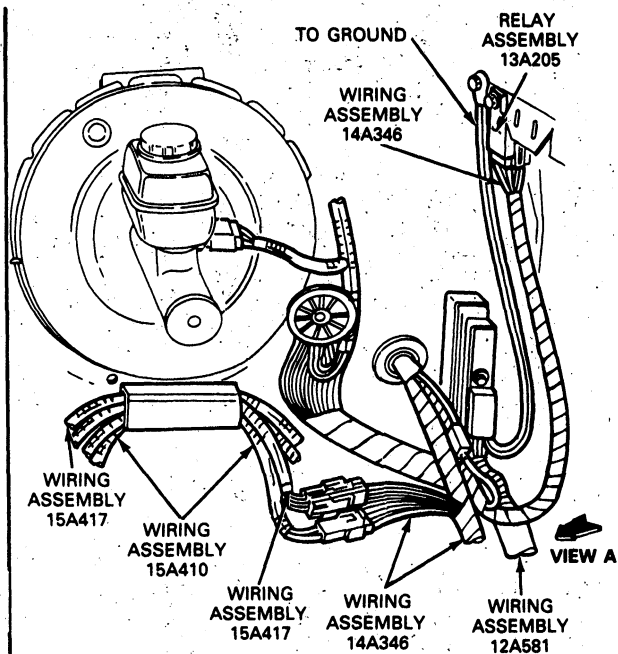
**K10559-2B**



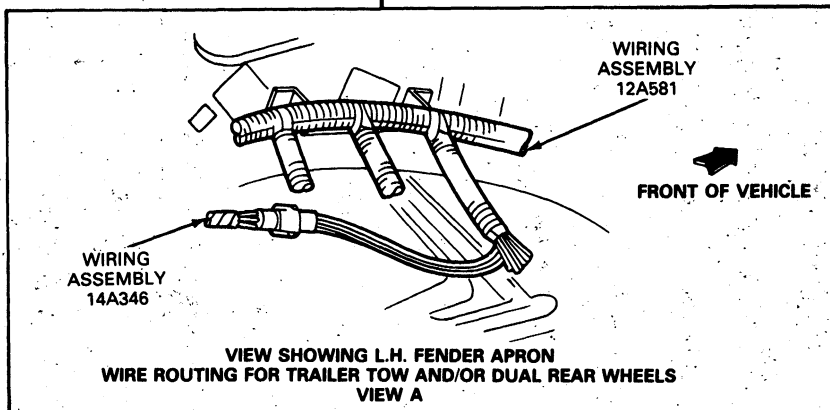
## REMOVAL AND INSTALLATION (Continued)

**Dash Panel and Relay Wiring—F-Series with Trailer Tow Package and/or Dual Rear Wheels**

VIEW SHOWING DASH PANEL WIRE ROUTING  
FOR DUAL REAR WHEELS OR  
CHASSIS CAB WITHOUT TRAILER TOW



VIEW SHOWING DASH PANEL WIRE ROUTING FOR TRAILER  
TOW WITH OR WITHOUT DUAL REAR WHEELS

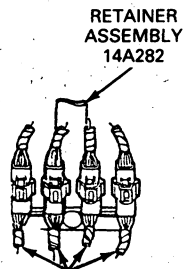
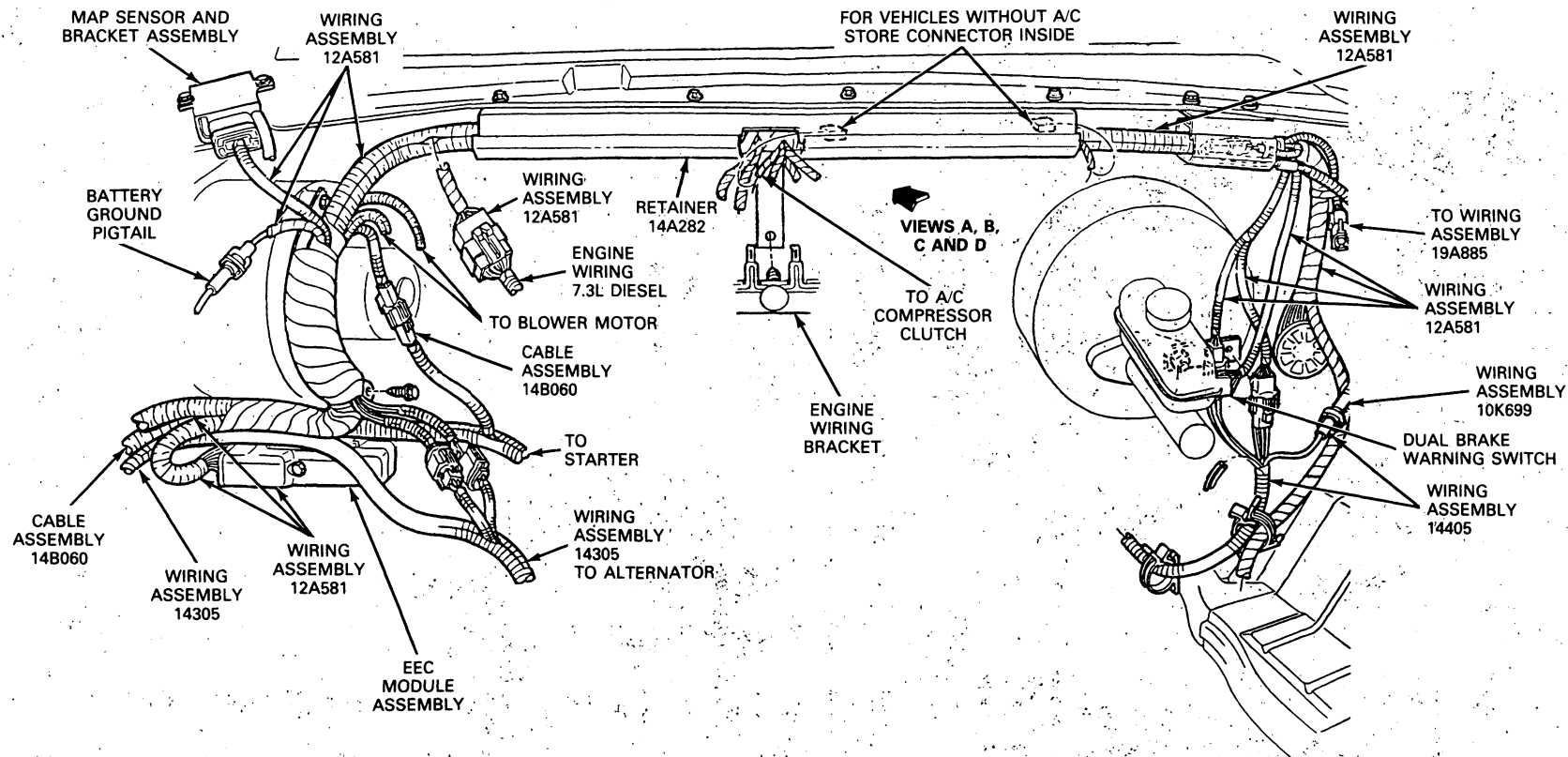


VIEW SHOWING L.H. FENDER APRON  
WIRE ROUTING FOR TRAILER TOW AND/OR DUAL REAR WHEELS  
VIEW A

K11968-2B

# REMOVAL AND INSTALLATION (Continued)

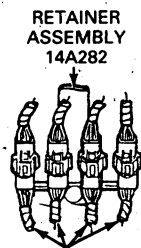
## Dash Panel Wiring—E-Series with (EFI) Gasoline and Diesel Engines



RETAINER ASSEMBLY  
14A282

WIRING ASSEMBLY  
14289

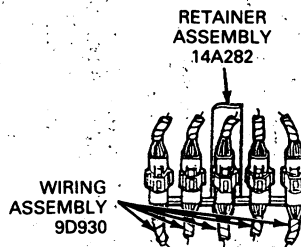
FOR VEHICLES WITH 4.9L ENGINE  
VIEW A



RETAINER ASSEMBLY  
14A282

WIRING ASSEMBLY  
9D930

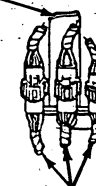
FOR VEHICLES WITH 5.0L AND  
5.8 UNDER 8500 LB. ENGINES  
VIEW B



RETAINER ASSEMBLY  
14A282

WIRING ASSEMBLY  
9D930

FOR VEHICLES WITH 5.8L OVER 8500 LB. AND  
7.5L ENGINES  
VIEW C



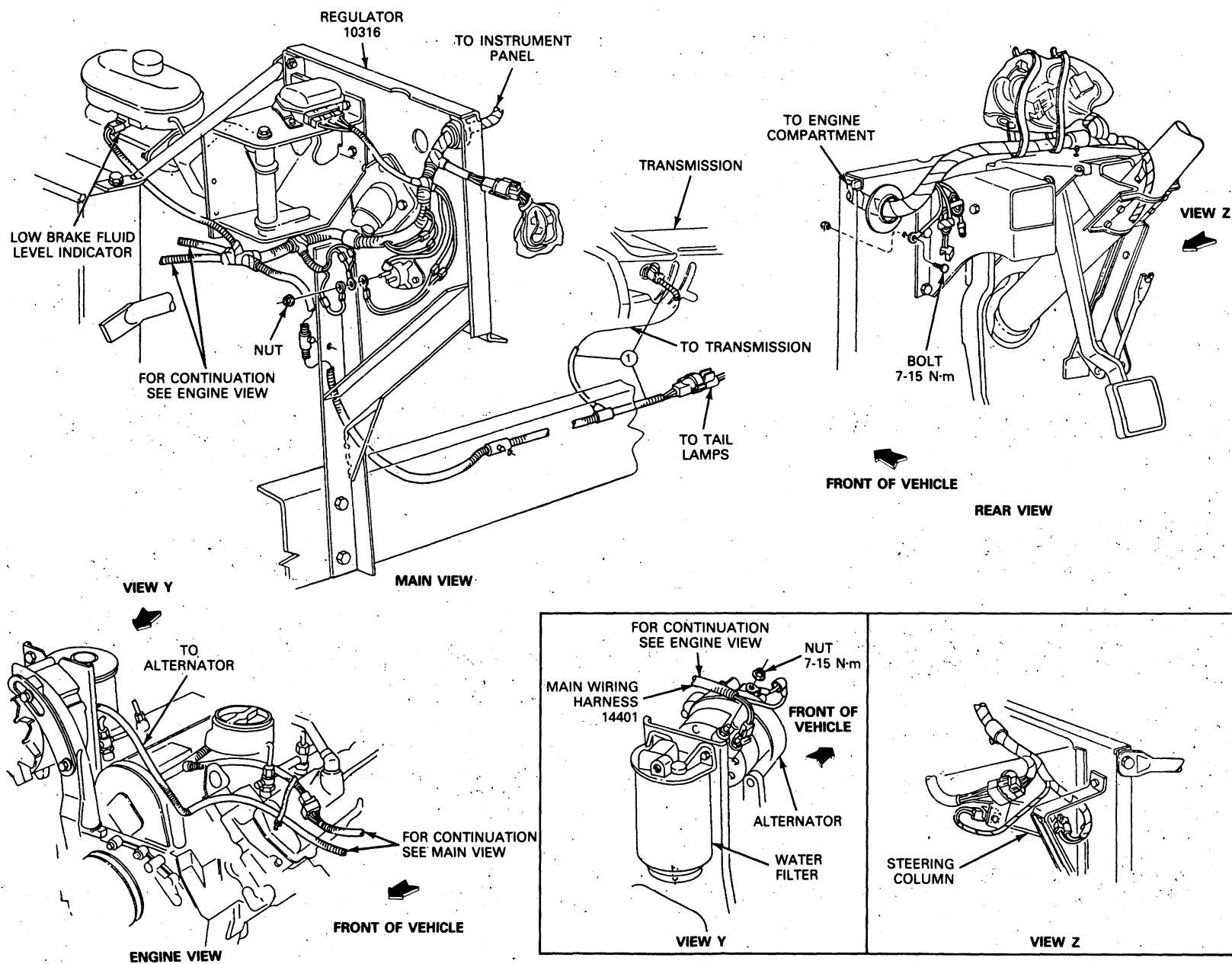
RETAINER ASSEMBLY  
14A282

WIRING ASSEMBLY  
9D930

FOR VEHICLES WITH 7.3L DIESEL ENGINE  
VIEW D

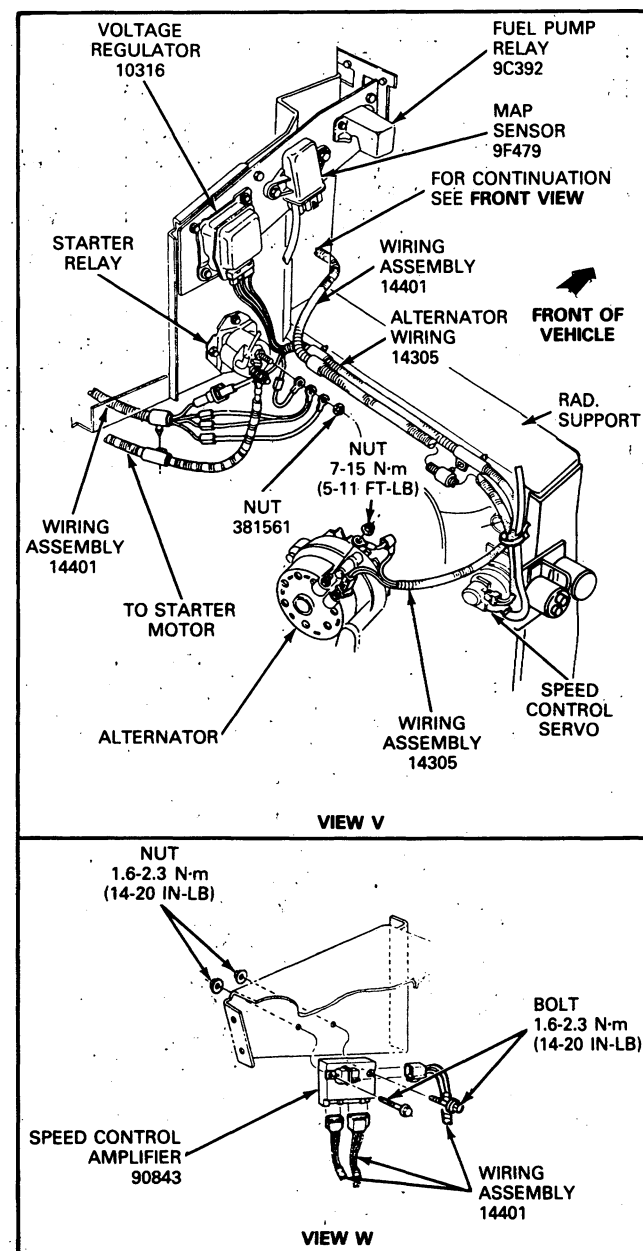
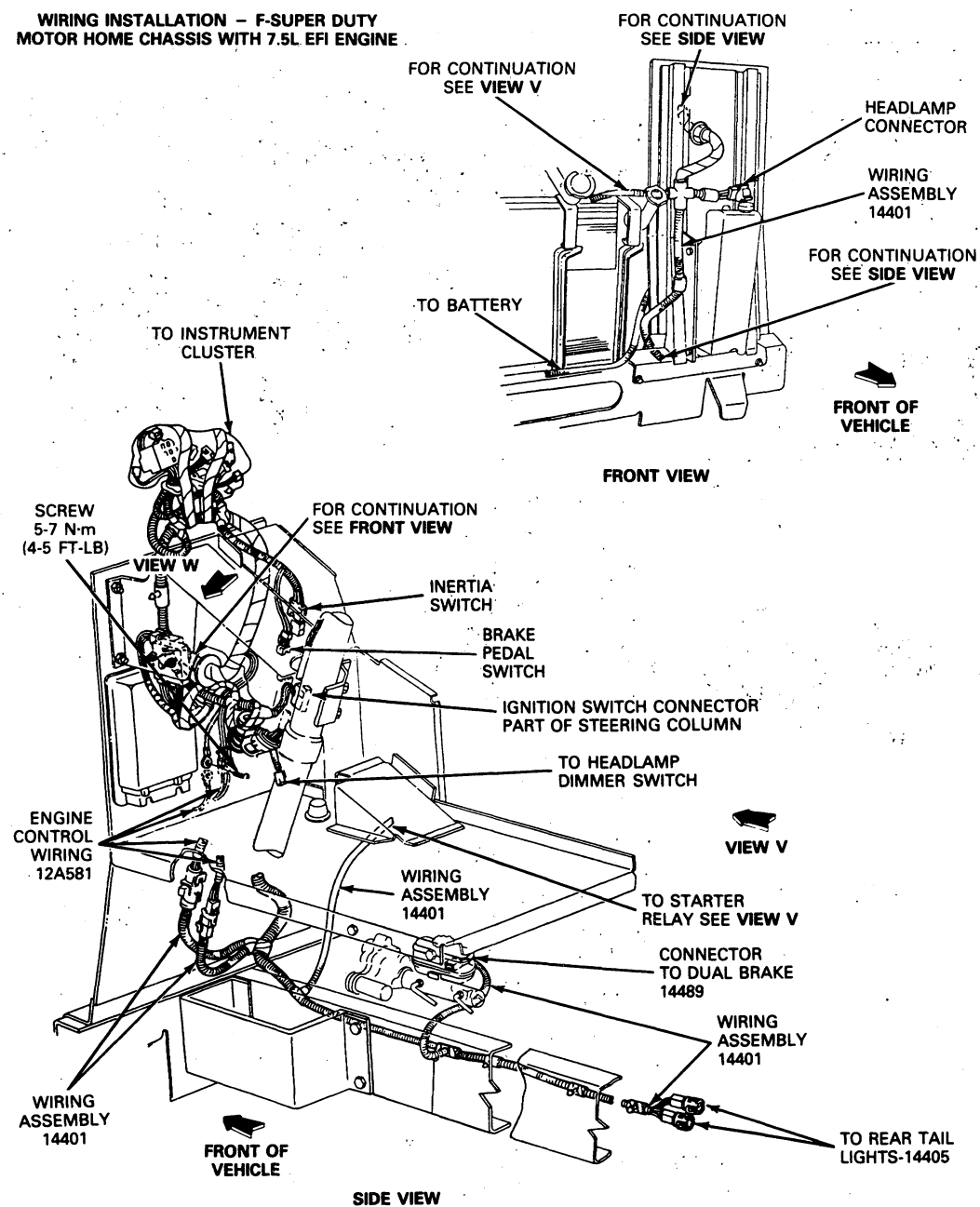
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## REMOVAL AND INSTALLATION (Continued)



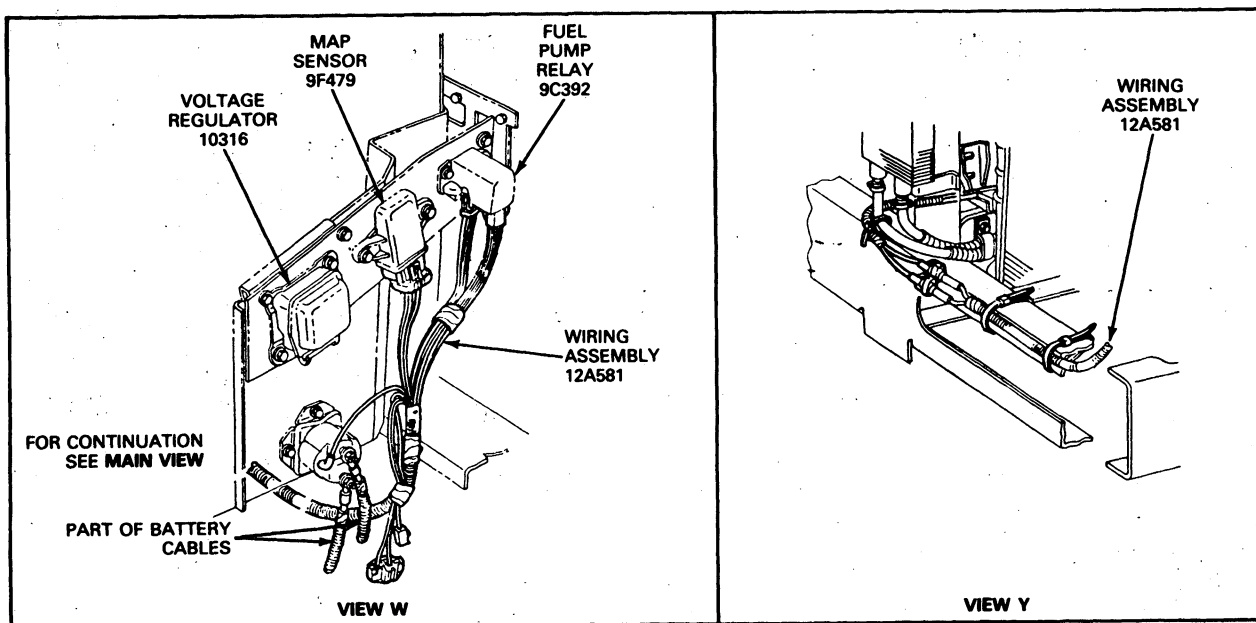
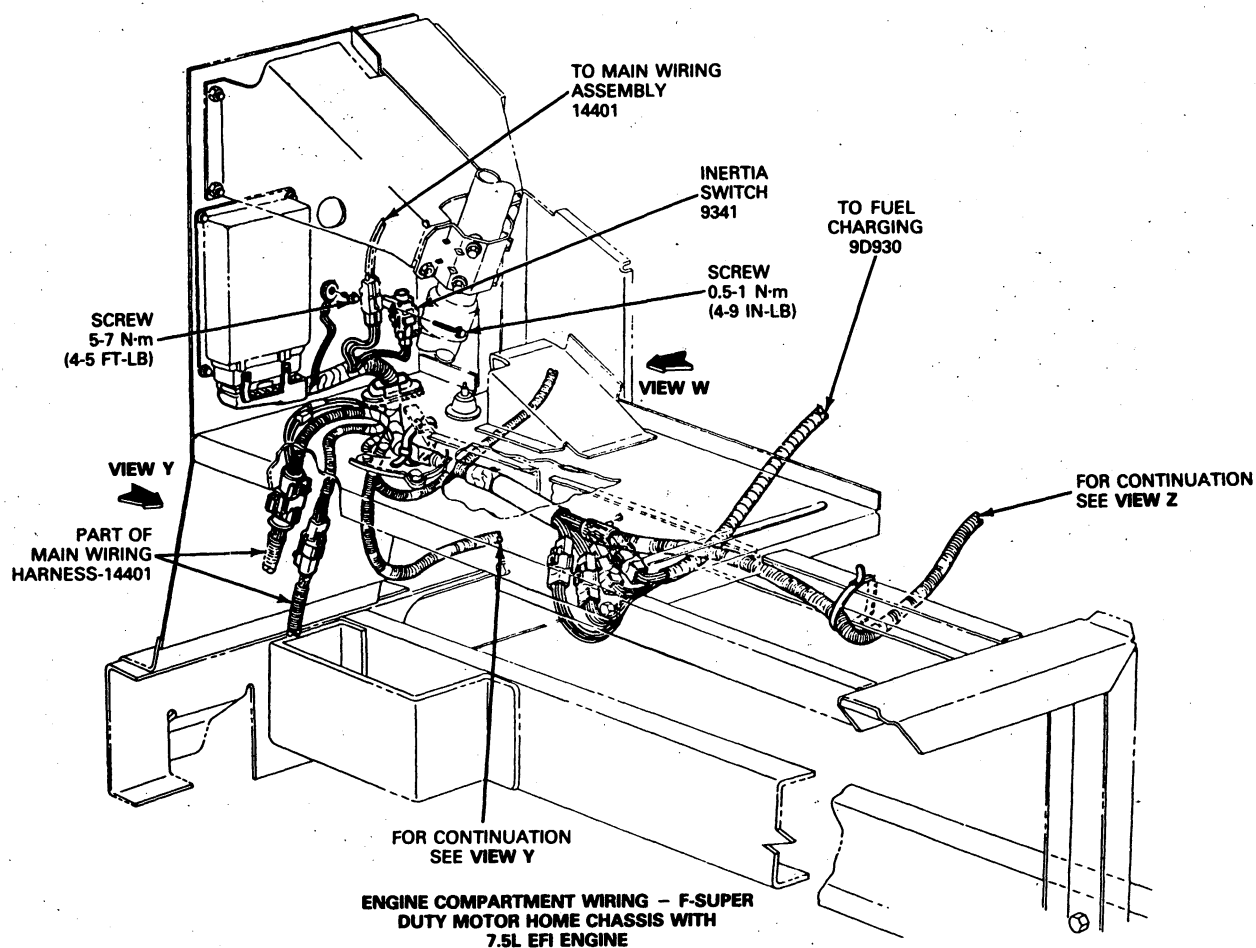
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WIRING INSTALLATION - F-SUPER DUTY  
MOTOR HOME CHASSIS WITH 7.5L EFI ENGINE

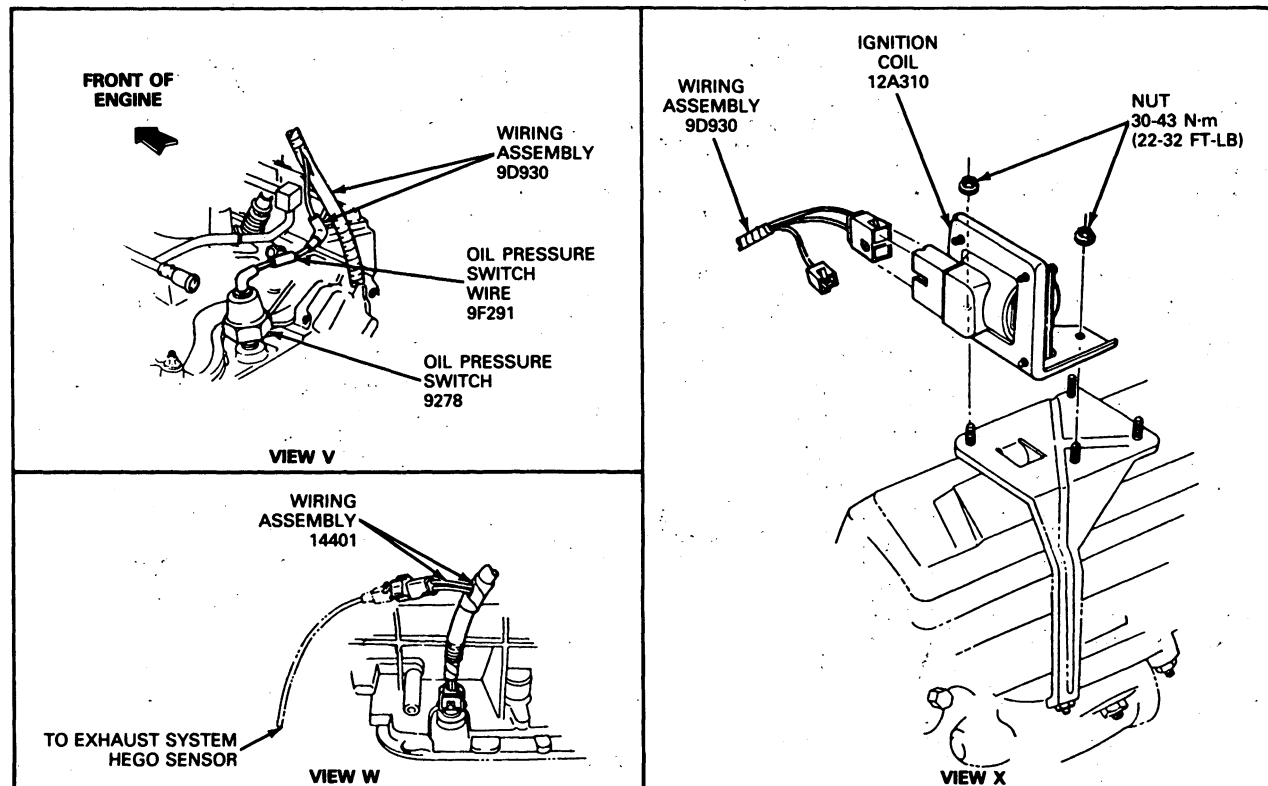
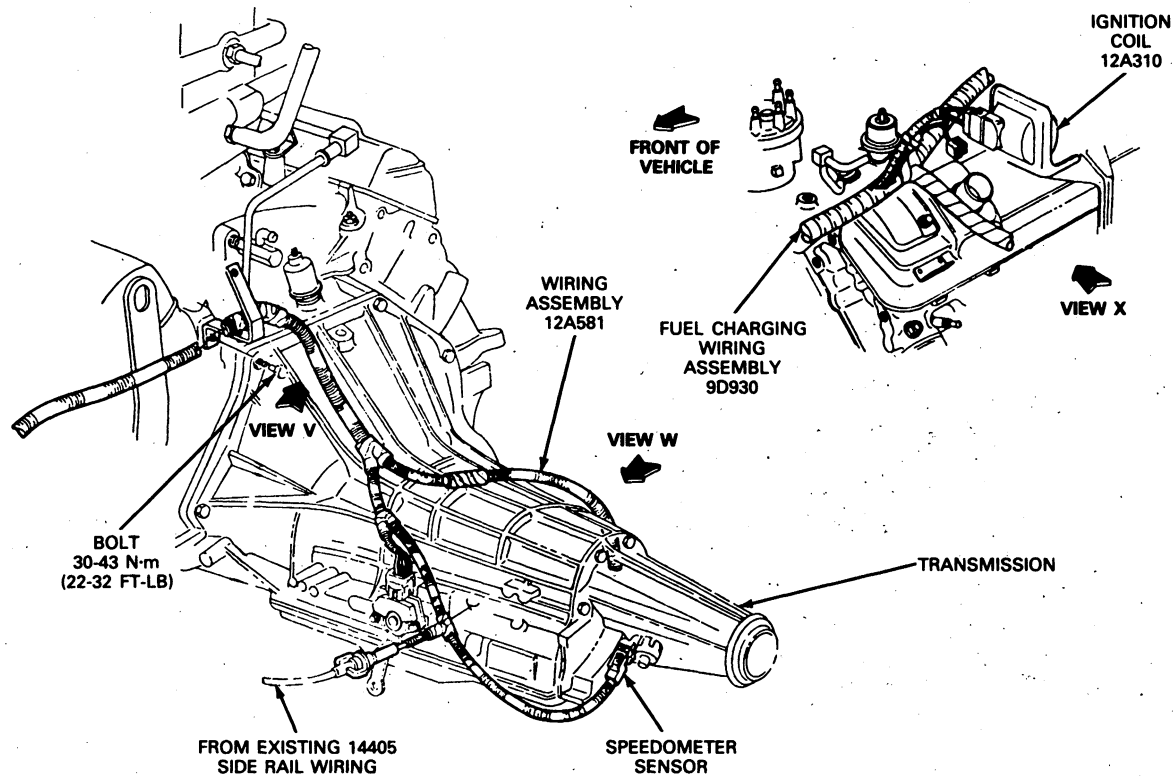
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## REMOVAL AND INSTALLATION (Continued)



K14462-2A

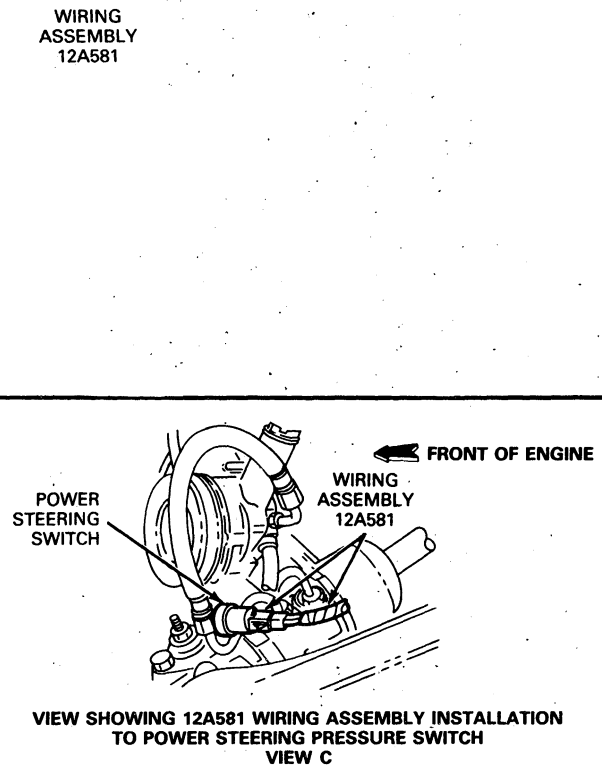
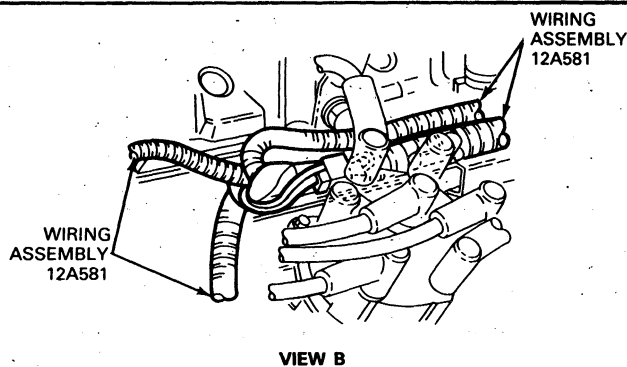
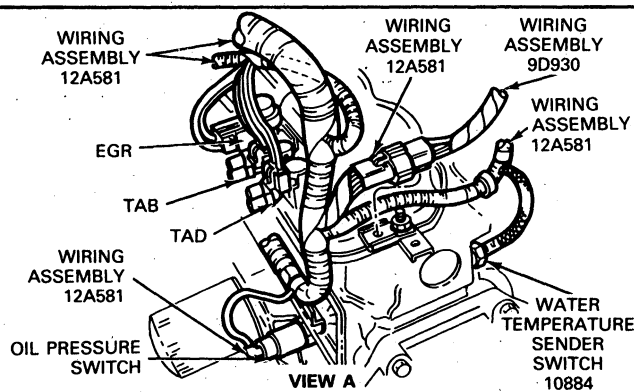
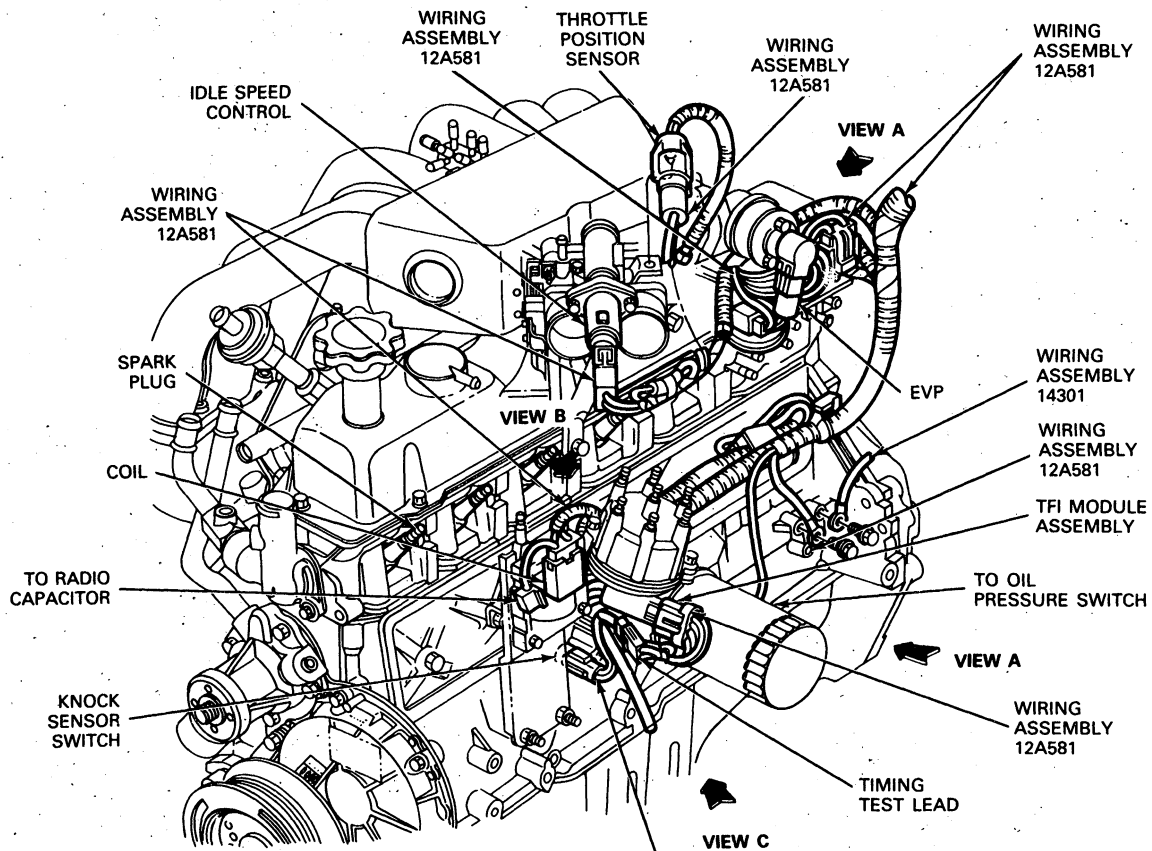
## REMOVAL AND INSTALLATION (Continued)



K14463-2A

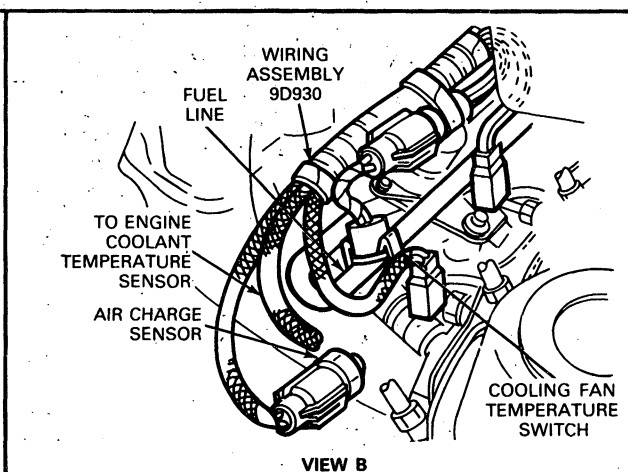
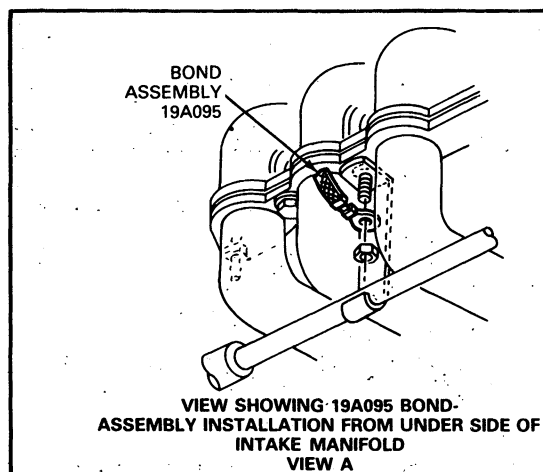
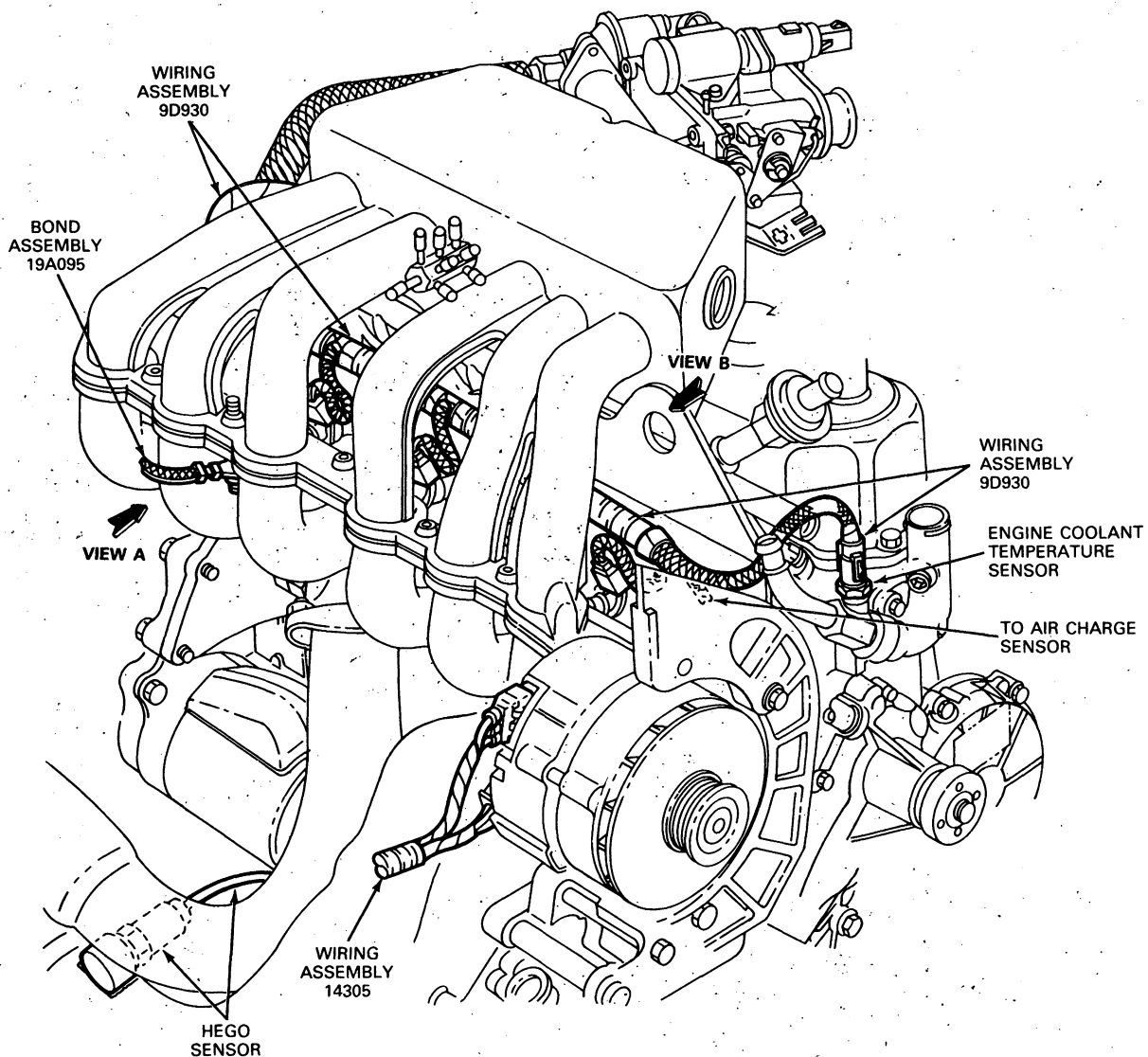
## REMOVAL AND INSTALLATION (Continued)

## Wiring, Engine—F-Series, Bronco and E-Series with 4.9L (EFI)—LH Side



**K11971-2A**

## REMOVAL AND INSTALLATION (Continued)

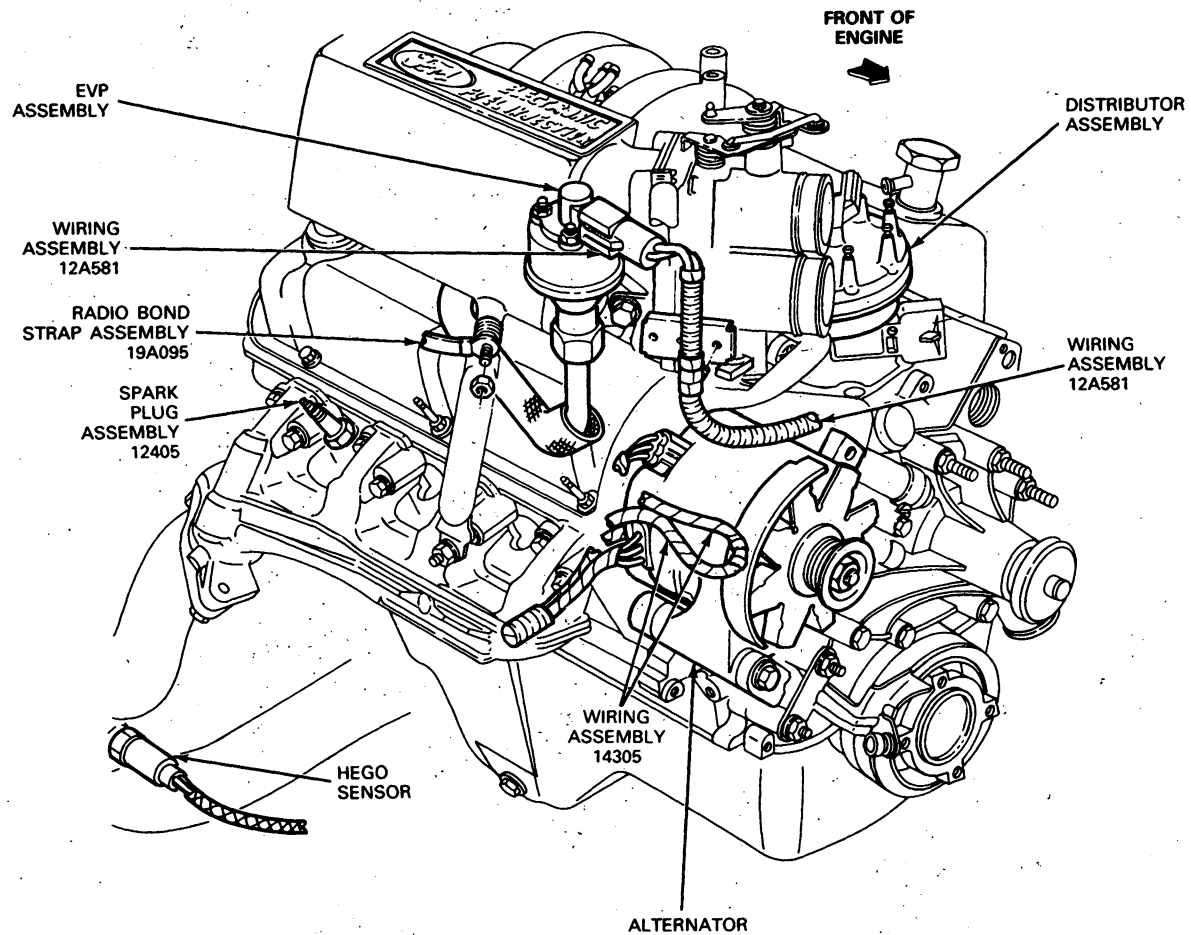
Wiring, Engine—F-Series, Bronco and E-Series  
with 4.9L (EFI)—RH Side

K11972-2A



## REMOVAL AND INSTALLATION (Continued)

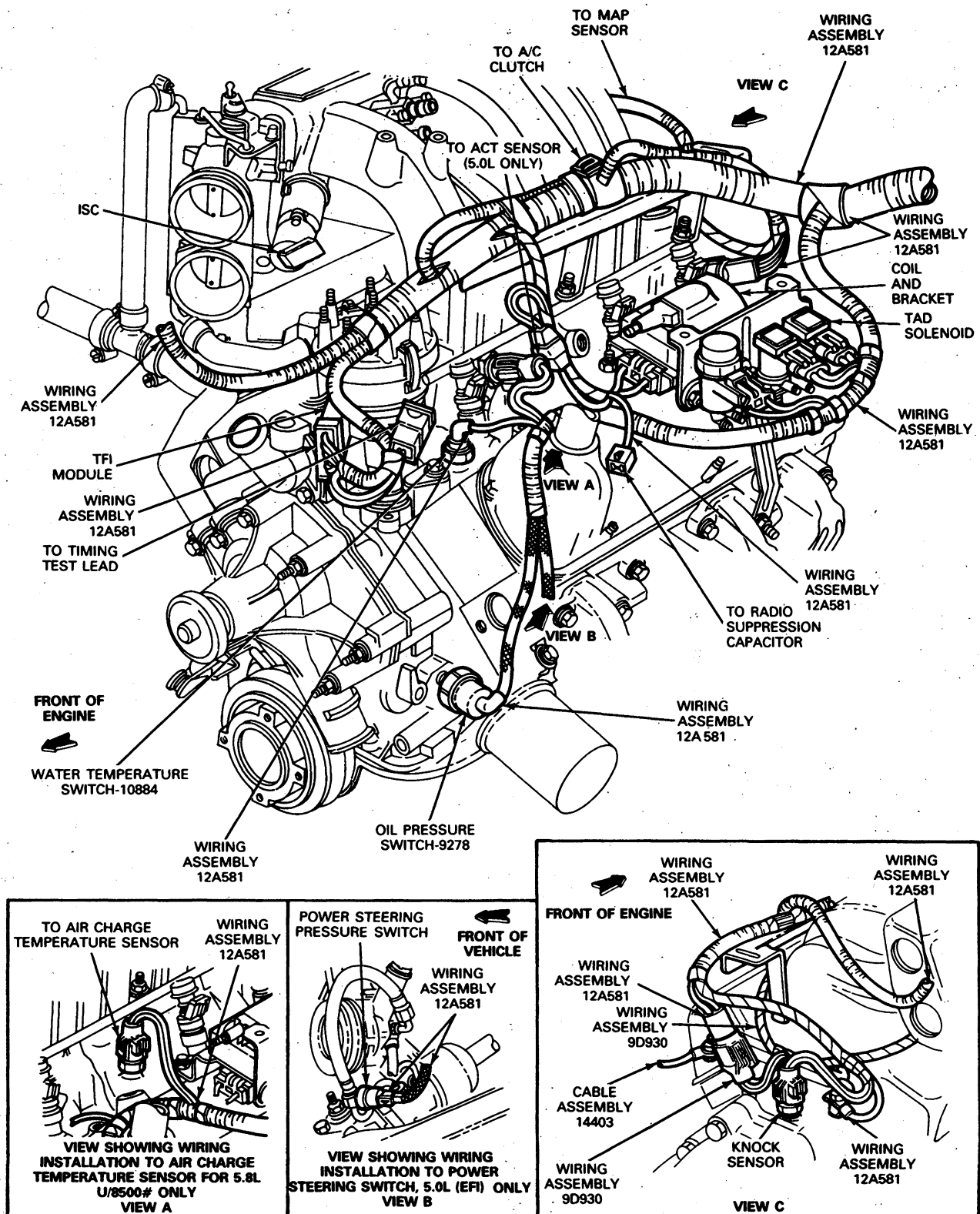
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K10594-2B

## REMOVAL AND INSTALLATION (Continued)

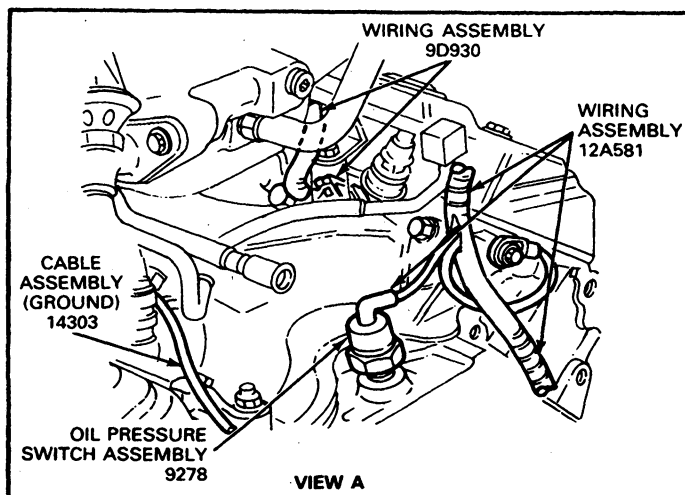
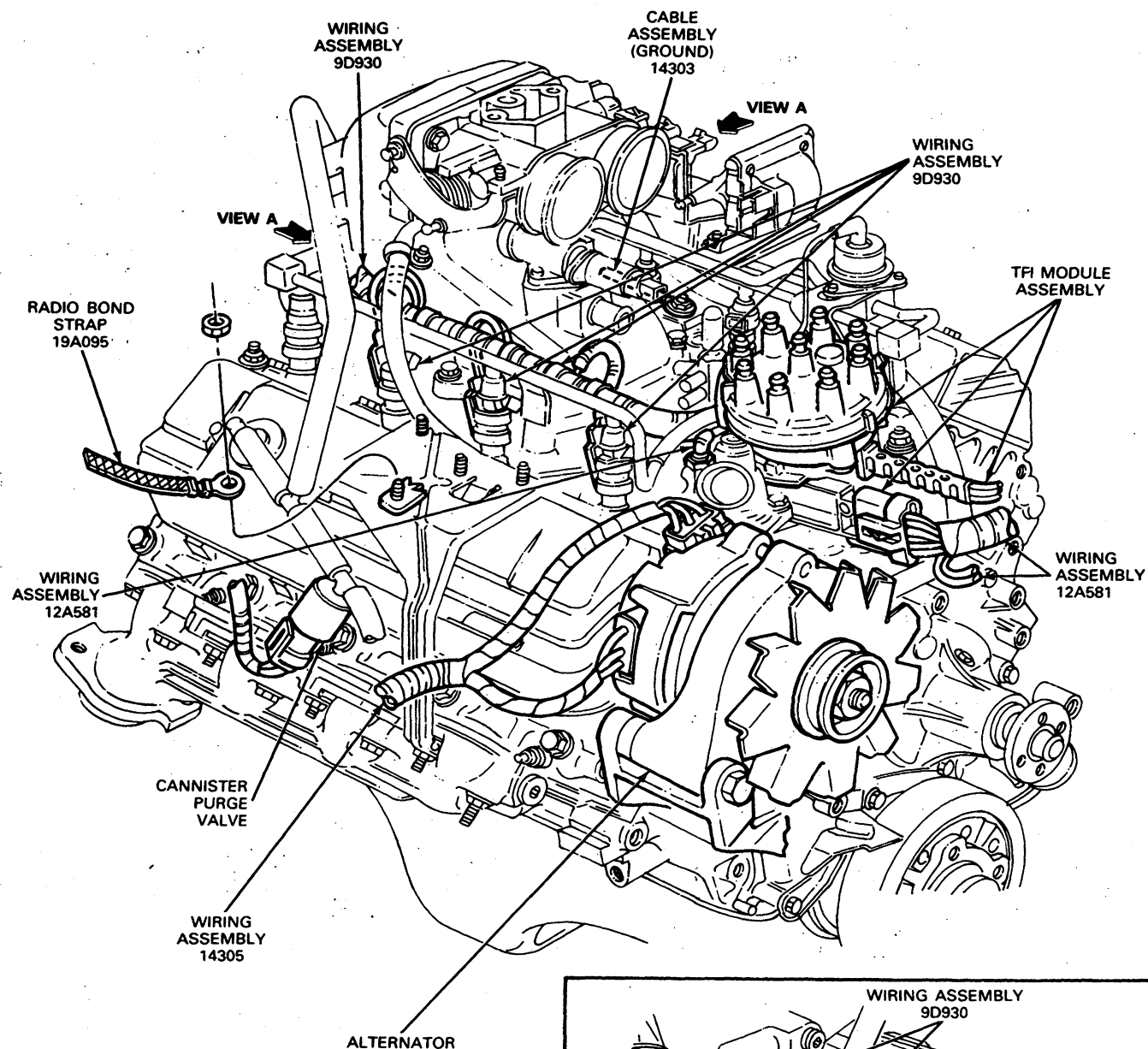
## Wiring, Engine—F-Series and Bronco with 5.0L and 5.8L (EFI)—LH Side



K9524-2C

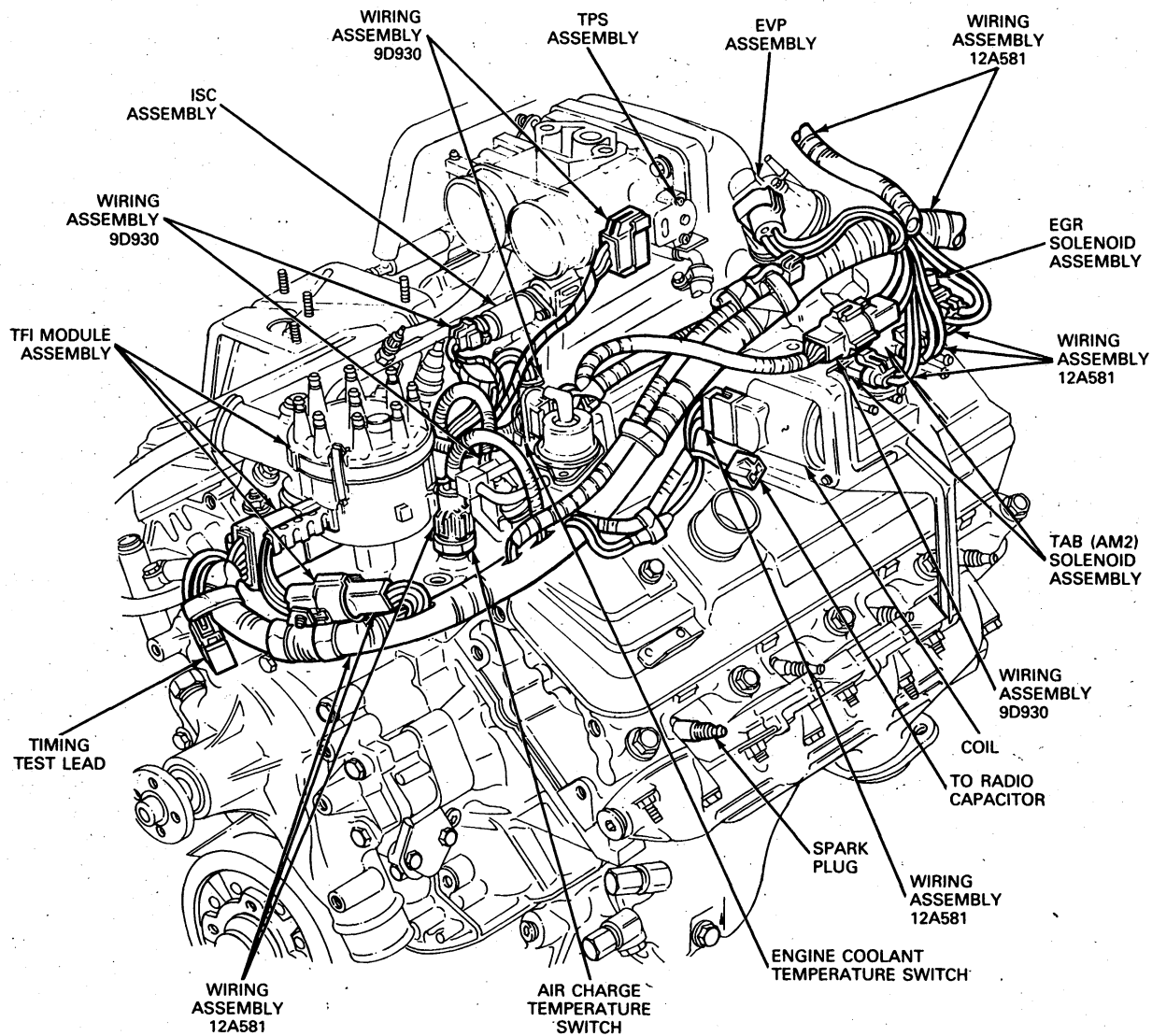
## REMOVAL AND INSTALLATION (Continued)

Wiring, Engine—F-250—350 and F-Super Duty  
with 7.5L (EFI)—RH Side



K11973-2B

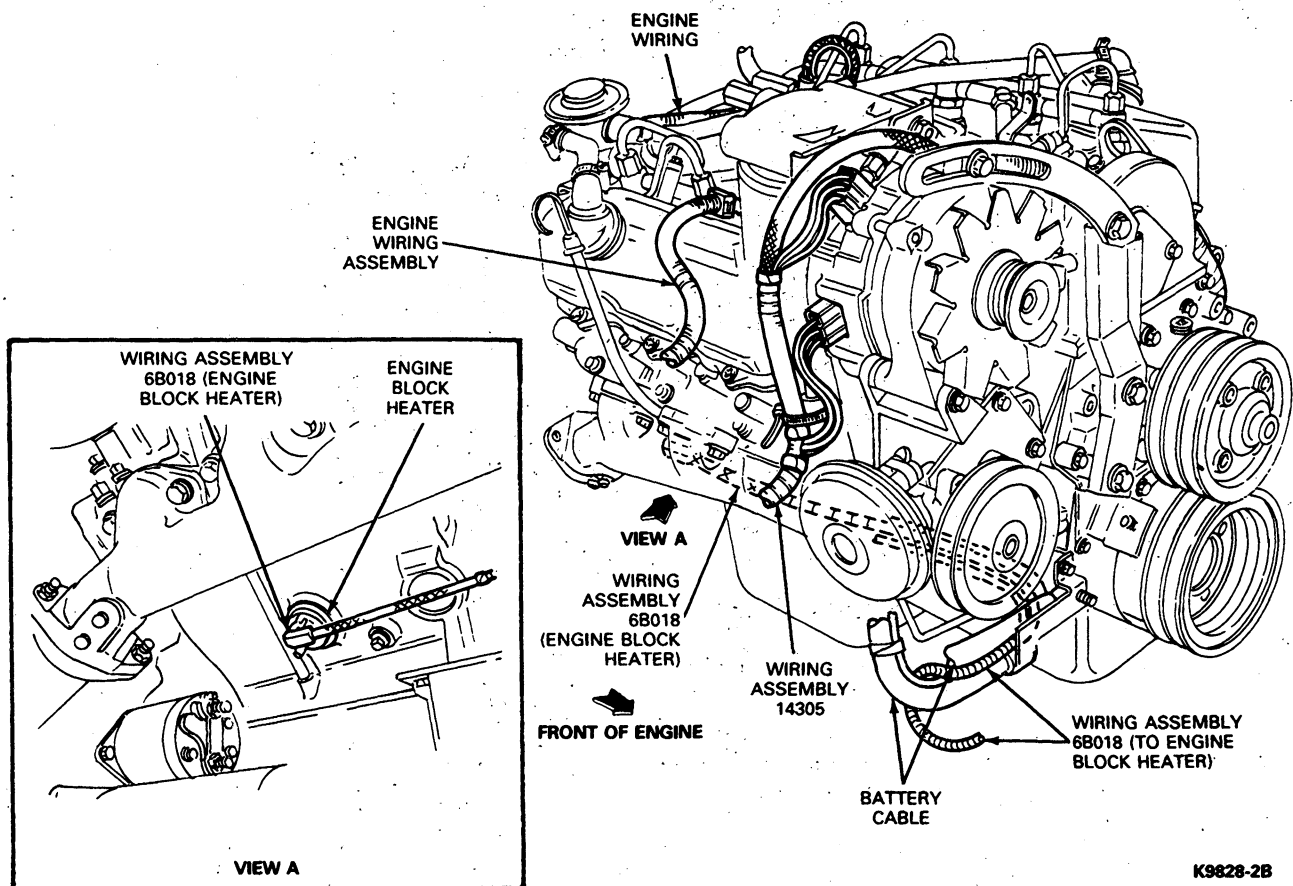
## REMOVAL AND INSTALLATION (Continued)

Wiring, Engine—F-250—350 and F-Super Duty  
with 7.5L (EFI)—LH Side

K11974-2A

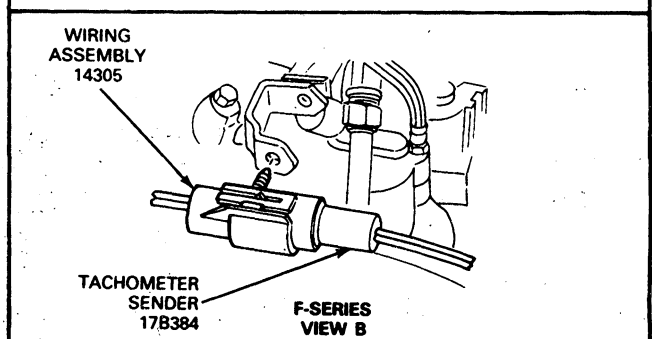
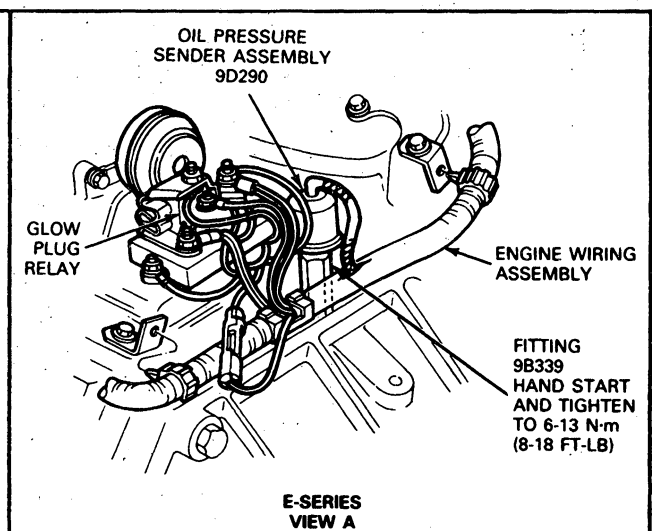
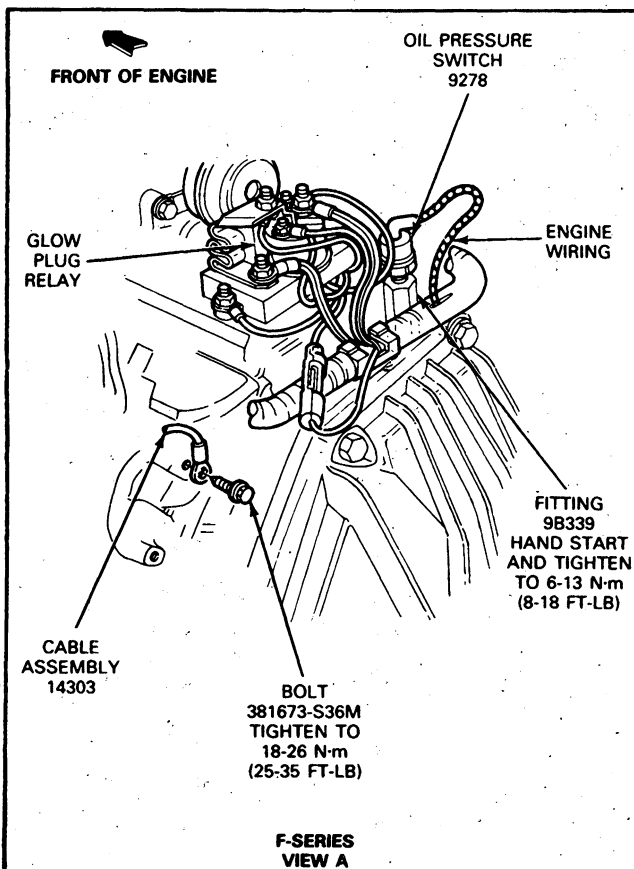
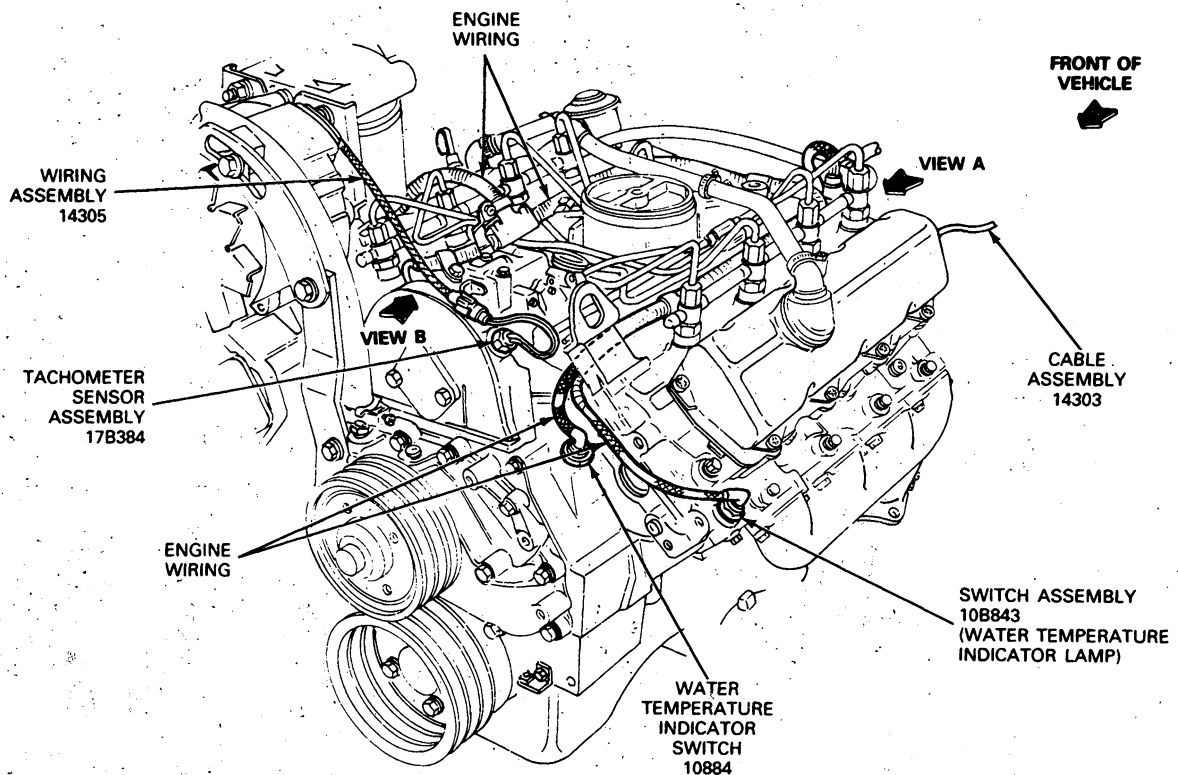
## REMOVAL AND INSTALLATION (Continued)

Wiring, Engine—F-250—350, F-Super Duty and  
E-Series with 7.3L Diesel—RH Side



## REMOVAL AND INSTALLATION (Continued)

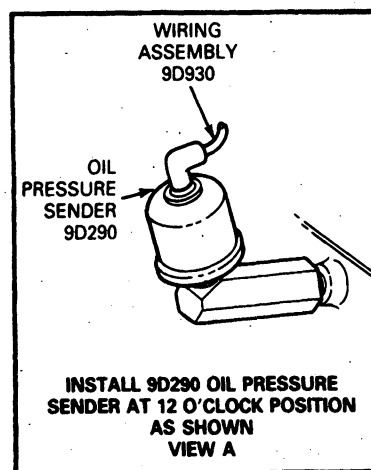
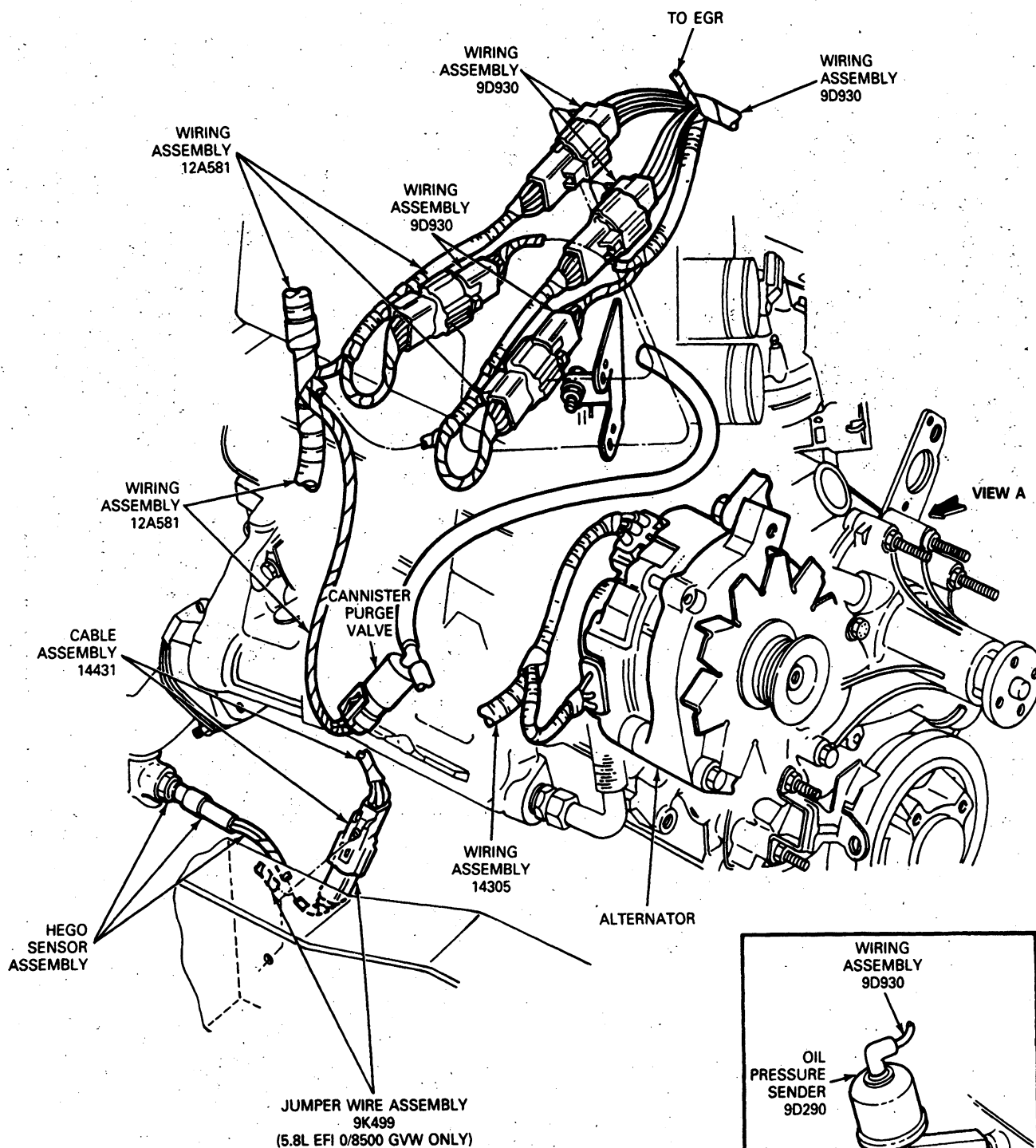
## Wiring, Engine—F-250—350, F-Super Duty and E-Series with 7.3L Diesel—LH Side



K9529-2C

## REMOVAL AND INSTALLATION (Continued)

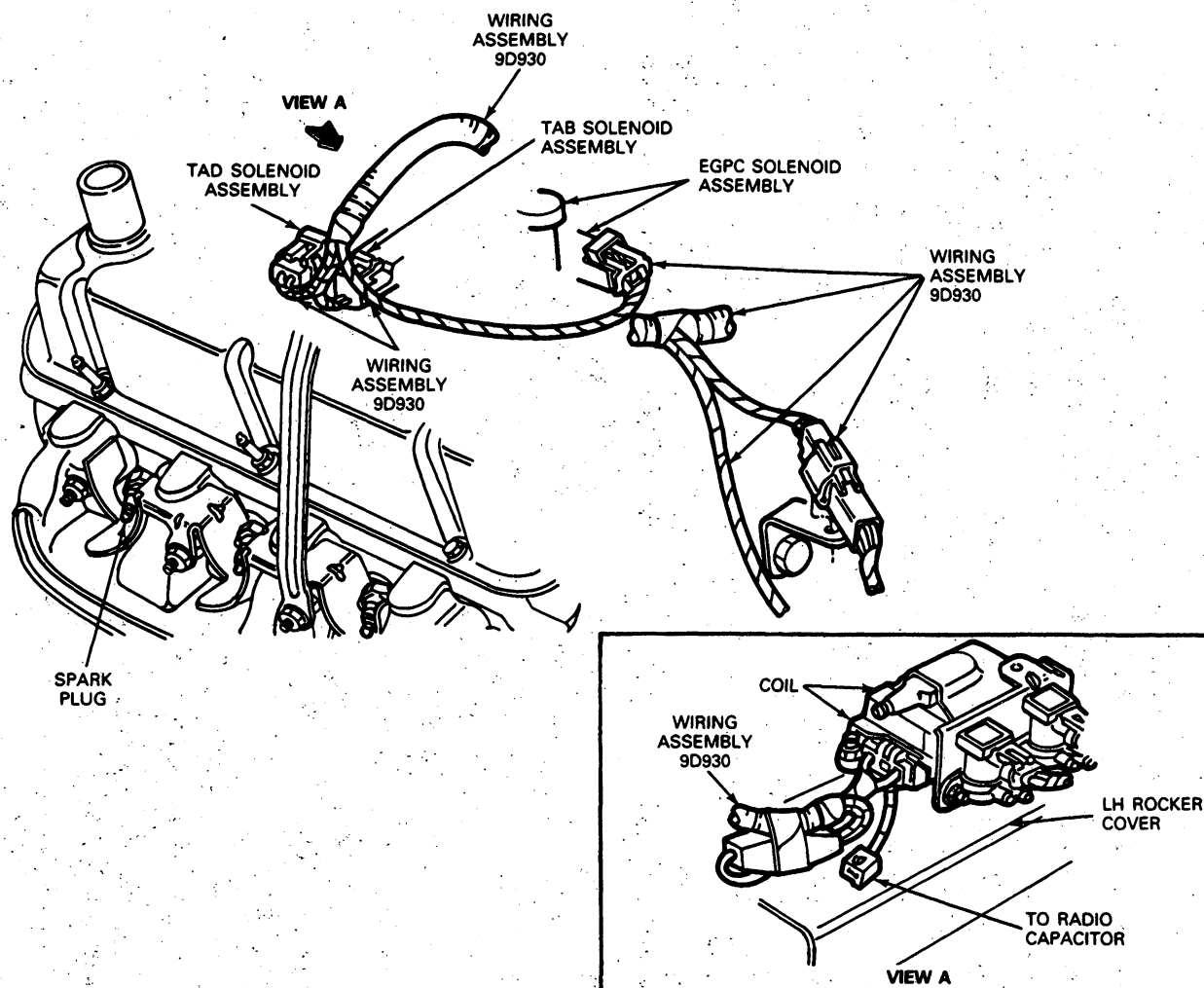
## Wiring, Engine—E-Series with 5.0L (EFI) and 5.8L (EFI)—RH Side



K11975-28

## REMOVAL AND INSTALLATION (Continued)

## Wiring, Engine—E-Series with 5.0L (EFI) and 5.8L (EFI)—LH Side

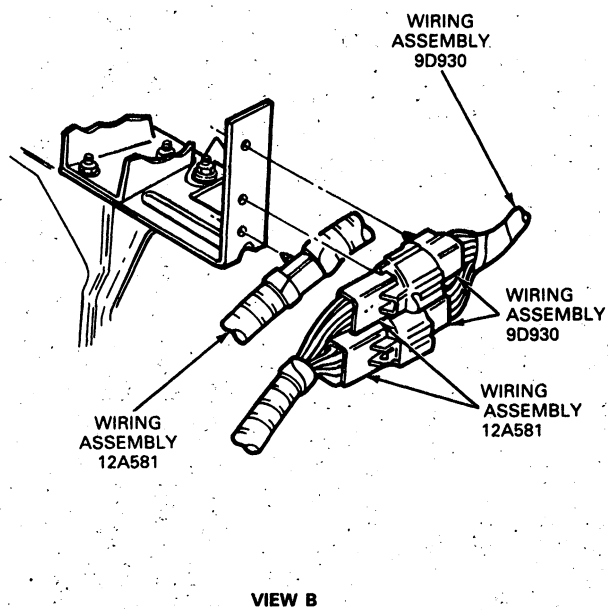
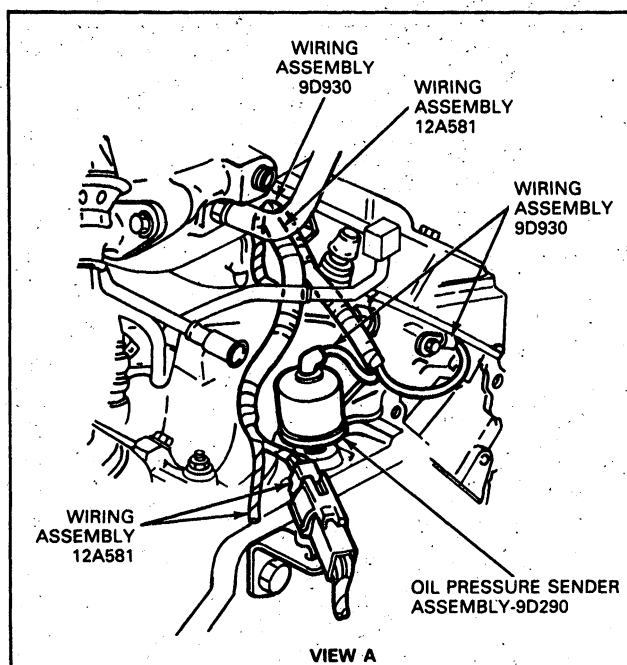
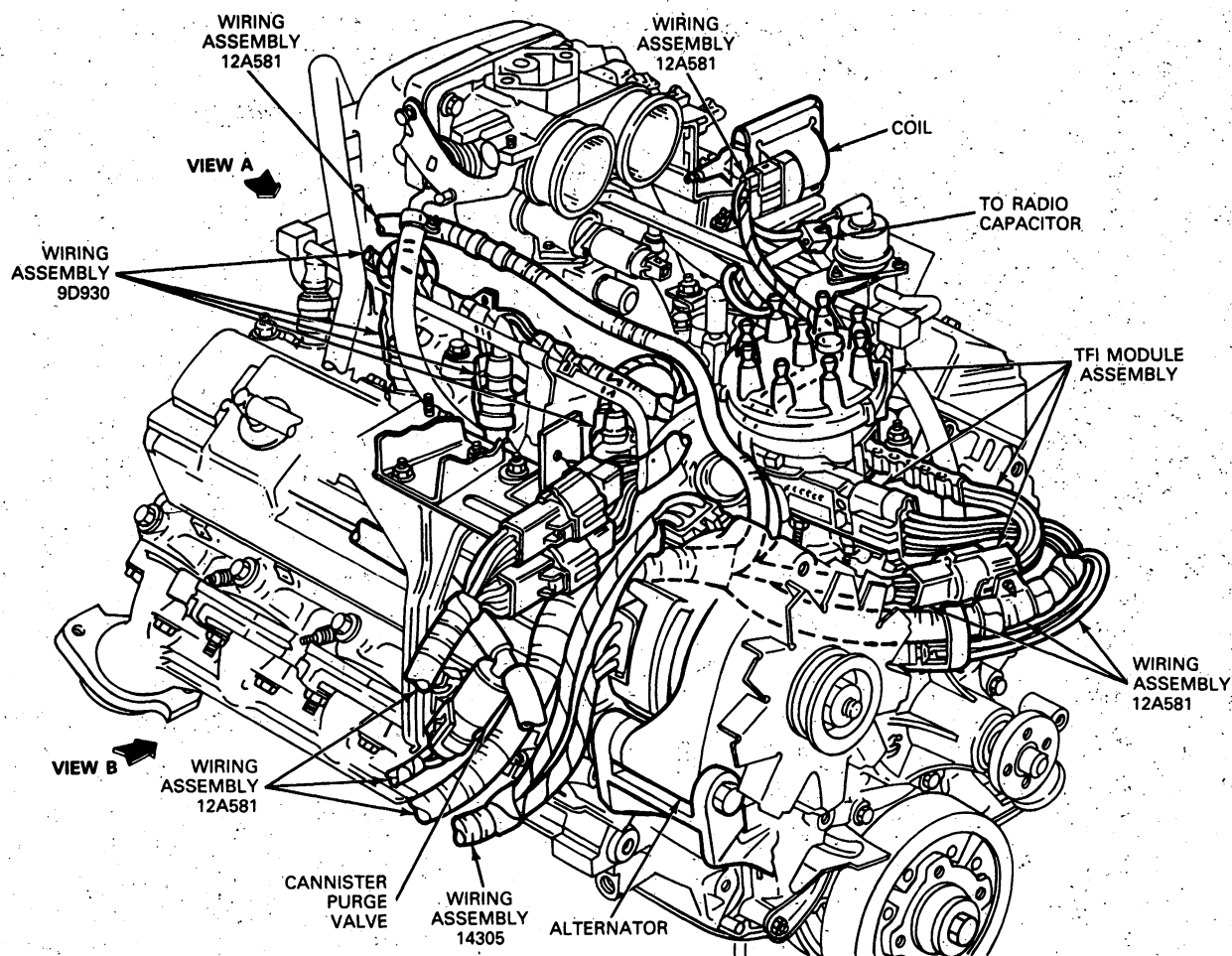


K11976-2A



## REMOVAL AND INSTALLATION (Continued)

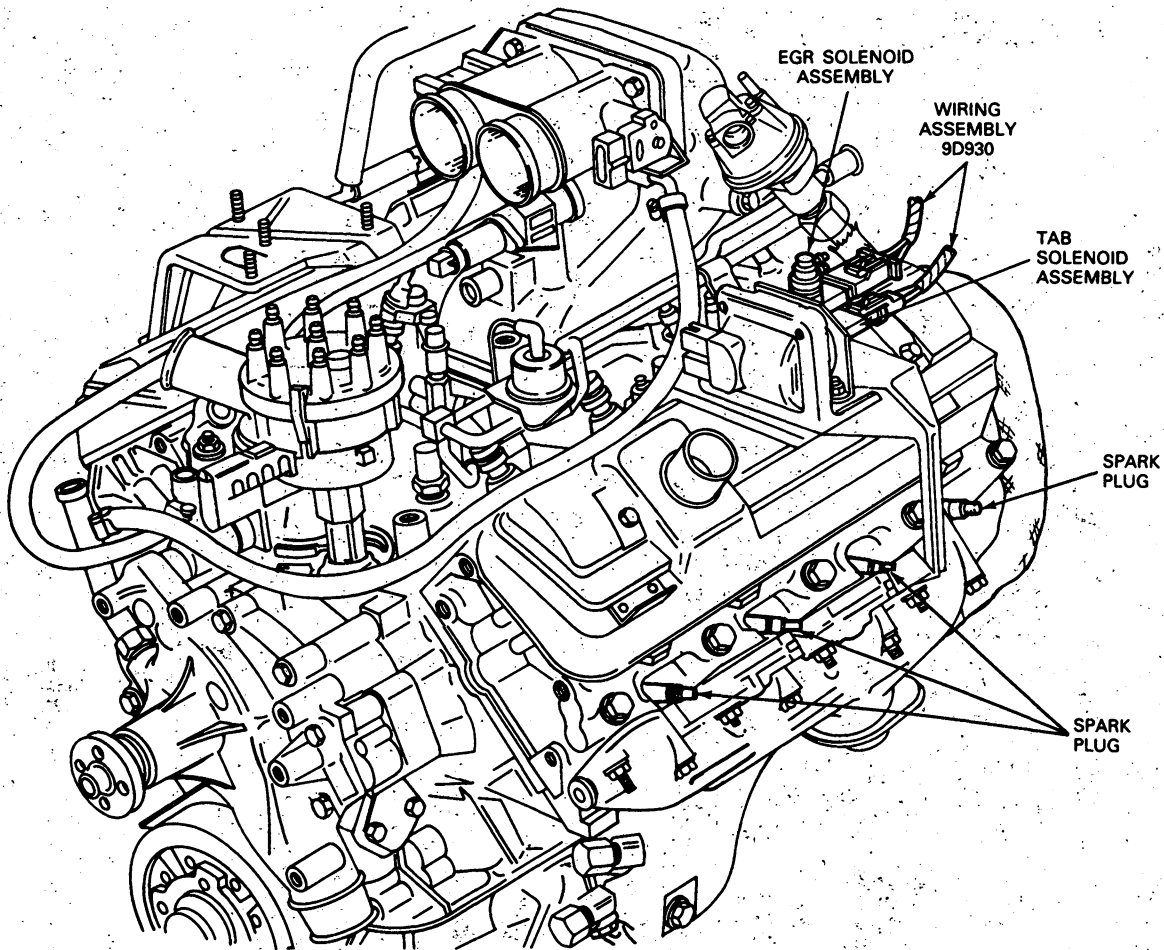
## Wiring, Engine—E-Series with 7.5L (EFI)—RH Side



K11977-2A

**REMOVAL AND INSTALLATION (Continued)**

**Wiring, Engine—E-Series with 7.5L (EFI)—LH  
Side**



K11978-2B

# SECTION 34-31 Fuses, Circuit Breakers and Fuse Links

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		REMOVAL AND INSTALLATION	
Fuse Link .....	34-31-1	Fuse Link .....	34-31-2
Fuse Panels .....	34-31-1	SPECIFICATIONS .....	34-31-7
DIAGNOSIS AND TESTING		VEHICLE APPLICATION .....	34-31-1
Fuse Link Continuity Test .....	34-31-2		
DISASSEMBLY AND ASSEMBLY			
Fuse Link .....	34-31-3		

## VEHICLE APPLICATION

All Models.

## DESCRIPTION

### Fuse Panels

Each vehicle has a fuse panel which contains most of the fuses used in the electrical system. The fuse panel for E-150—E-350 is located on a mounting bracket under the instrument panel left of the steering column (Fig. 1). The fuse panels for F-150—F-350, F-Super Duty and Bronco are located on the dash panel under the instrument panel left of the steering column (Fig. 2).

The circuit protection charts in Specifications give the location and values of all the circuits containing fuses or circuit breakers for the various vehicle lines.

### Fuse Link

The fuse link is a short length of special, Hypalon (high temperature) insulated wire, integral with the engine compartment wiring harness and should not be confused with standard wire. It is several wire gauges smaller than the circuit which it protects. Under no circumstances should a fuse link replacement repair be made using a length of standard wire cut from bulk stock or from another wiring harness.

The higher melting temperature properties and additional thickness of the Hypalon insulation will usually allow the undersized internal fuse wire to melt

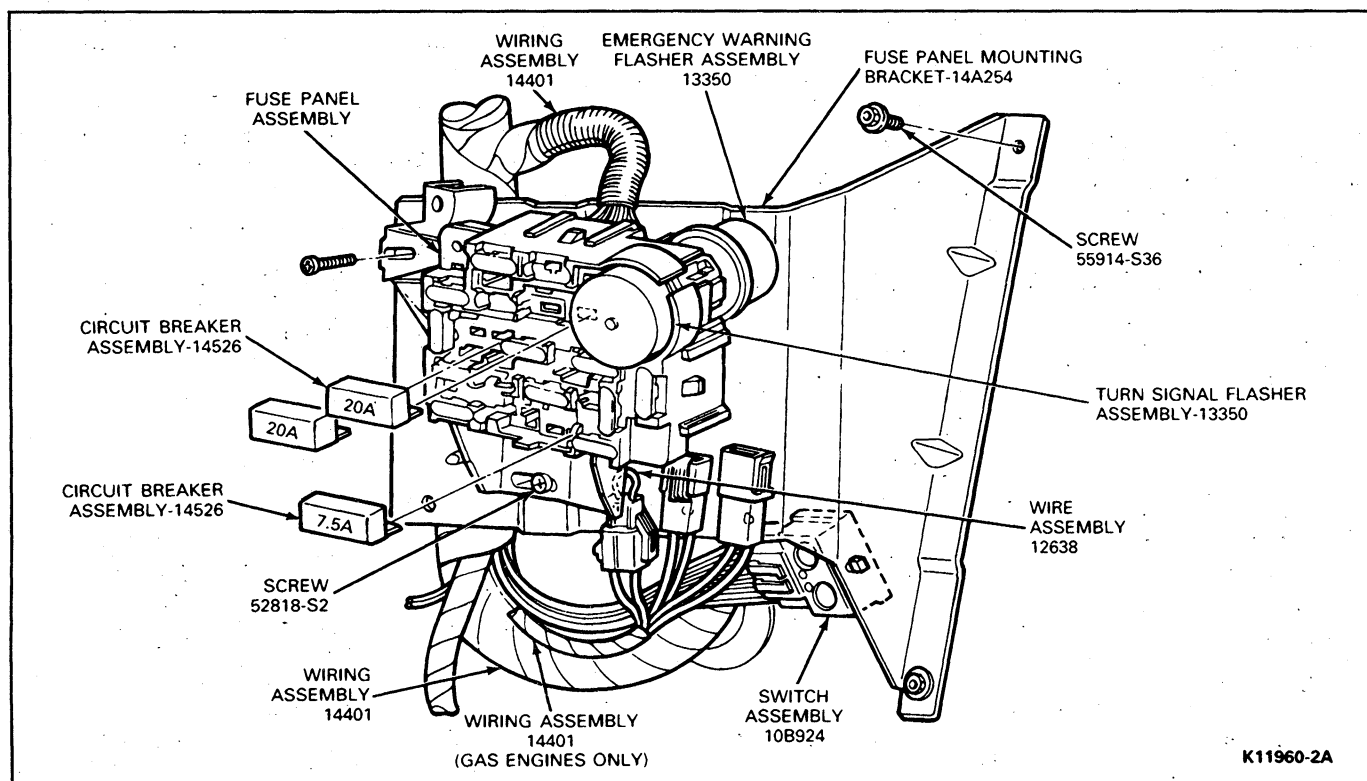


FIG. 1 Fuse Panel—E-150—E-350

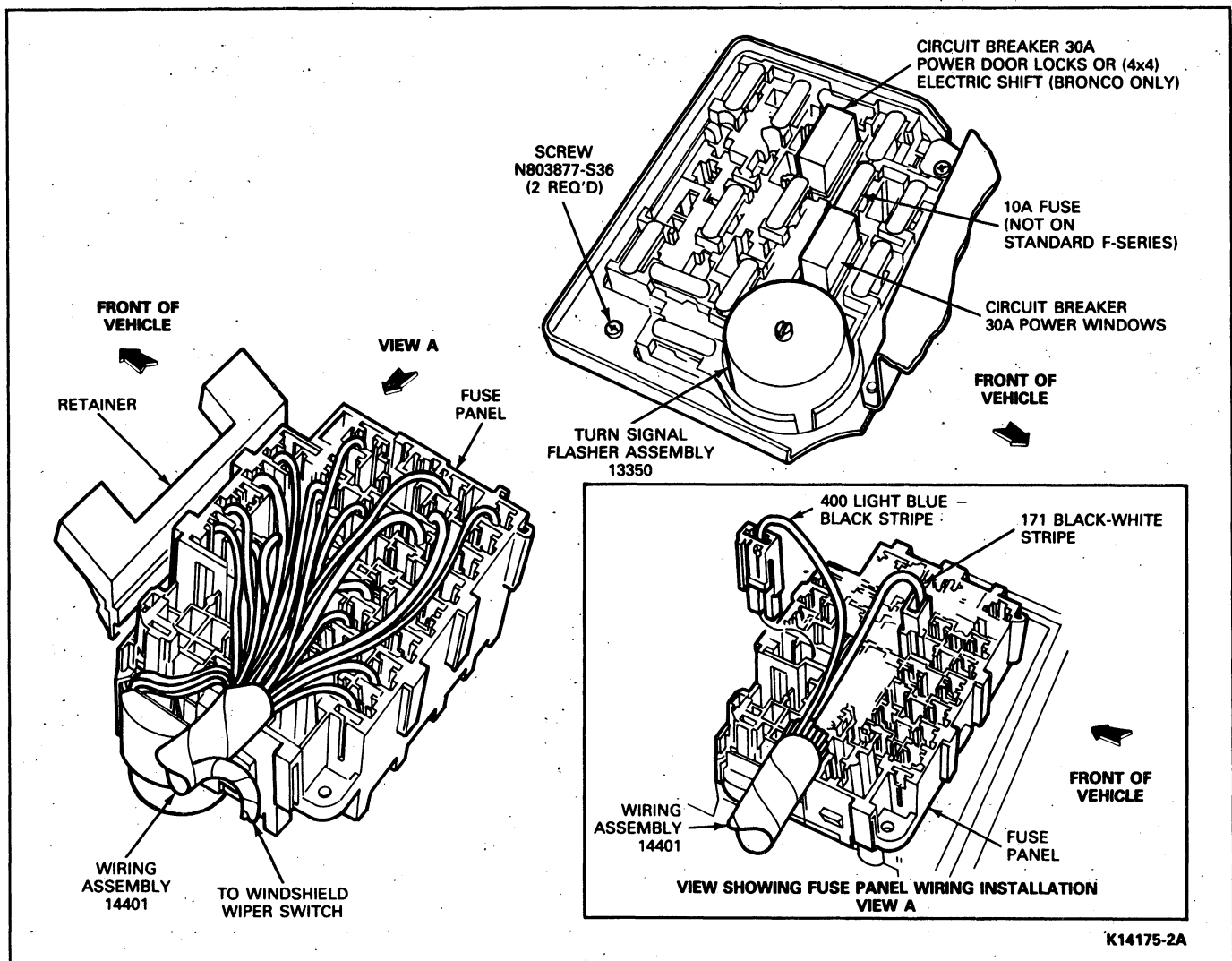


FIG. 2 Fuse Panel—F-150—F-350, F-Super Duty and Bronco

and disintegrate within the Hypalon casing with little damage to the high temperature insulation other than discoloration and/or bubbling of the insulation surface. In extreme cases of excessive circuit current the insulation may separate after the fuse wire has disintegrated. However, the bare wire will seldom be exposed. When it becomes difficult to determine if the fuse link is burned open, perform a continuity test. When heavy current flows, such as when a booster battery is connected incorrectly or when a short to ground occurs in the wiring harness, the fuse link burns out and protects the alternator and/or wiring.

Production fuse links have a flag moulded on the wire or on the terminal insulator. Color identification of the flag or connector is Blue-20 Ga. wire, Red-18 Ga. wire, Yellow-17 Ga. wire, Orange-16 Ga. wire, or Green-14 Ga. wire. Fig. 3 shows typical fuse link installations.

## DIAGNOSIS AND TESTING

### Fuse Link Continuity Test

1. Make certain first that the battery is OK, then turn on the headlamps or any accessory. If the headlamps or an accessory do not operate, a fuse link is probably burned out.

2. Where there are two fuse links (Fig. 3), repeat Step 1 to test the fuse link that protects the vehicle equipment.

To test the fuse link that protects the alternator, make certain that the battery is OK, then check with a voltmeter or 12-volt test lamp for voltage at the BAT terminal of the alternator. No voltage indicates that the alternator fuse link is probably burned out.

## REMOVAL AND INSTALLATION

### Fuse Link

Refer to Figs. 4 and 5.

If it becomes necessary to replace a fuse link in a wiring assembly, make sure the replacement fuse link is a duplicate of the one removed with respect to gauge, length and insulation. Original and Ford replacement fuse links have insulation that is flame proof. Do not fabricate a fuse link from ordinary wire because the insulation may not be flameproof.

If a circuit protected by a fusible link becomes inoperative, inspect for a blown fuse link. If the fuse link wire insulation is burned or opened, disconnect the feed wire part of the wiring and cut out the damaged portion

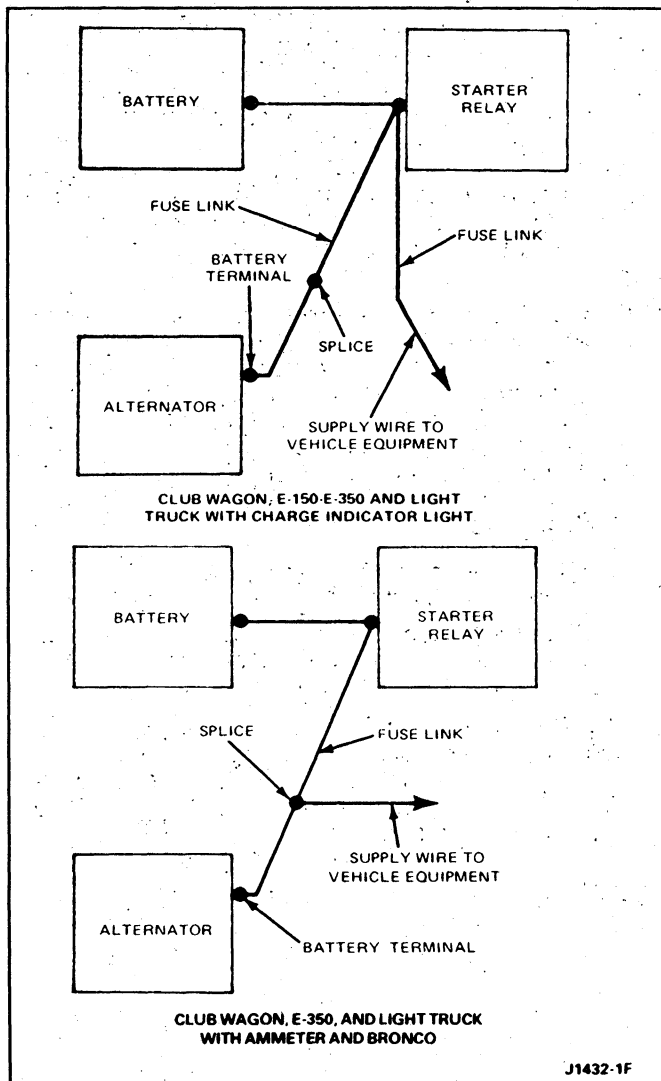


FIG. 3 Fuse Link Installation

as close as possible behind the splice in the harness. If the damaged fuse link is between two splices (weld points in the harness), cut out the damaged portion as close as possible to the weld points.

Two examples are the air conditioner feed and high speed blower motor switch feed circuits, which use special 17 gauge wire fuse links to meet the special protection requirements. These two fuse links are located in the engine compartment, one near the large rubber grommet in the center area of the dash panel, the other near the starter motor relay on the RH fender apron. They are covered with a special vinyl tube shielding which must slide freely between the two welded ends. The shielding is necessary to prevent fumes, oil or fuel from saturating the fuse link area.

When replacing one or both air conditioner fuse links, carefully remove the existing shielding after cutting out the damaged wire. Install the shielding over the new fuse link(s) before crimping the fuse links to the wire ends. Some wiring assemblies have more than one fuse link fed from a single, heavy gauge wire in the same location.

To replace the fuse link proceed as follows:

1. Some fuse links shown have an eyelet terminal for a 5/16-inch stud on one end. When the terminal is

not required, use one of the fuse links shown in Figs. 4 and 5, with the insulation stripped from both ends.

2. Disconnect the battery ground cable.
3. Disconnect the fuse link and/or fuse link eyelet terminal from the battery terminal of the starter relay. On some vehicle applications, the fuse link is looped outside of the wire harness, behind the point at which the harness is clipped to the RH rocker cover above the starter.
4. Cut the fuse link and the splice(s) from the wire(s) to which it is attached.

Disconnect the feed wire part of the wiring and cut out the damaged portion as close as possible behind the splice in the harness. If the damaged fuse link is between two splices (weld points in the harness), cut out the damaged portion as close as possible to the weld points.

5. Splice and solder the new fuse link to the wire(s) from which the old link was cut. Use rosin core solder. Wrap the splice(s) completely with Electrical Tape C8AZ-19628-D, F, G, H or equivalent.
6. Securely connect the eyelet terminals (if any) to the battery stud on the starter relay.
7. Install the repaired wiring as before, using existing clips, if provided.
8. Connect the ground cable to the battery.

## DISASSEMBLY AND ASSEMBLY

### Fuse Link

To service any blown fuse link (Fig. 3) use the following procedure:

1. Determine which circuit is damaged, its location and the cause of the open fuse link. If the damaged fuse link is one of three fed by a common No. 10 or 12 gauge feed wire, determine the specific affected circuit.
2. Disconnect the battery ground cable.
3. Cut the damaged fuse link from the wiring harness and discard it. If the fuse link is one of three circuits fed by a single feed wire, cut it out of the harness at each splice end and discard it.
4. Identify and procure the proper fuse link and butt connectors (Figs. 4 and 5) for attaching the fuse link to the harness.
5. To service a two-link group when only one link has blown and other link is not damaged:
  - a. Cut out blown link (two places) (Fig. 6).
  - b. Position correct eyelet type service fusible link and bare butt connector.
  - c. Solder serviced joint and insulate with tape (Fig. 6).
6. To service any fuse link in a 3-link group with one feed:
  - a. After cutting the open link out of the harness, cut each of the remaining undamaged fuse links close to the feed wire weld.
  - b. Strip approximately 12.7mm (1/2 inch) of insulation from the detached ends of the two good fuse links. Then insert two wire ends into

one end of Butt Connector D3AZ-14488-Y or Z, or equivalent (Fig. 5) and carefully push one stripped end of the replacement fuse link into the same end of the butt connector. Crimp all three firmly together.

NOTE: Care must be taken when fitting the three fuse links into the butt connector as the internal diameter is a snug fit for three wires. Make sure to use a Wire Fitting Crimping Tool T67S-17018-A or equivalent. Pliers or side cutters will not apply the proper crimp to retain the wires and withstand a pull test.

- c. After crimping the butt connector to the three fuse links, cut the weld portion from the feed wire and strip approximately 12.7mm (1/2 inch) of insulation from the cut end. Insert the stripped end into the open end of the butt connector and crimp very firmly.
- d. To attach the remaining end of the replacement fuse link, strip approximately 12.7mm (1/2 inch) of insulation from the wire end of the circuit from which the blown fuse link was removed. Firmly crimp Butt Connector D3AZ-14488-Z, or Y or equivalent (Fig. 5) to the stripped wire. Then, insert the end of the replacement link into the other end of the butt connector and crimp firmly.
- e. Using rosin core solder with a consistency of 60 percent tin and 40 percent lead, solder the connectors and the wires at the repairs.

Insulate with Electrical Tape C8AZ-19628-D, F, G, H or equivalent (Fig. 5).

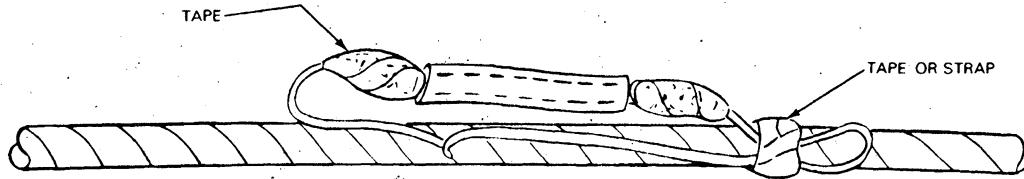
7. To replace any fuse link on a single circuit in a harness, cut out the damaged portion, strip approximately 12.7mm (1/2 inch) of insulation from the two wire ends and attach the appropriate replacement fuse link to the stripped wire ends with two proper size butt connectors. Solder the connectors and wires and insulate with tape, as in Step 5.
8. To repair any fuse link which has an eyelet terminal on one end such as the charging circuit (Fig. 5), cut off the open fuse link behind the weld, strip approximately 12.7mm (1/2 inch) of insulation from the cut end and attach the appropriate new eyelet fuse link to the cut stripped wire with an appropriate size butt connector (Fig. 5). Solder the connectors and wires at the repair and insulate with tape, as in Step 5.
9. Connect the negative battery cable to the battery and test the system for proper operation.

NOTE: Do not mistake a resistor wire for a fuse link. The resistor wire is generally longer and has print stating, "Resistor-don't cut or splice."

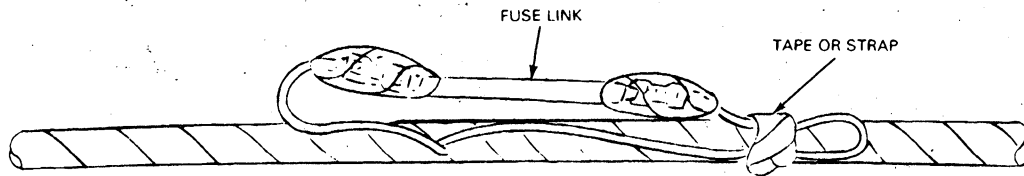
NOTE: When attaching a single No. 16, 17, 18 or 20 gauge fuse link to a heavy gauge wire, always double the stripped wire end of the fuse link before inserting and crimping it into the butt connector for positive wire retention.

## FUSE LINK AND BUTT CONNECTOR SERVICE PROCEDURES

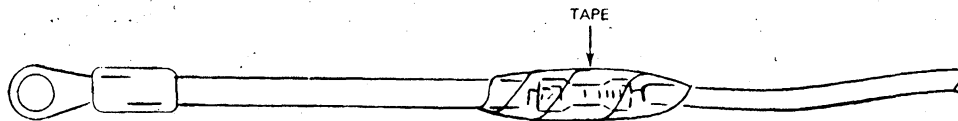
REMOVE EXISTING VINYL TUBE SHIELDING  
REINSTALL OVER FUSE LINK BEFORE CRIMPING  
FUSE LINK TO WIRE ENDS



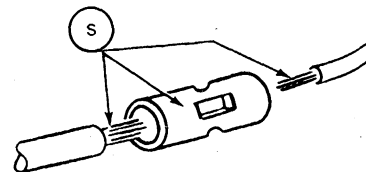
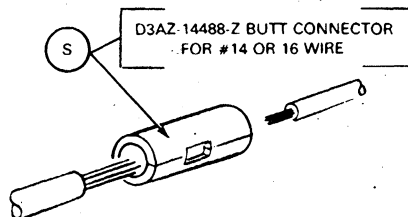
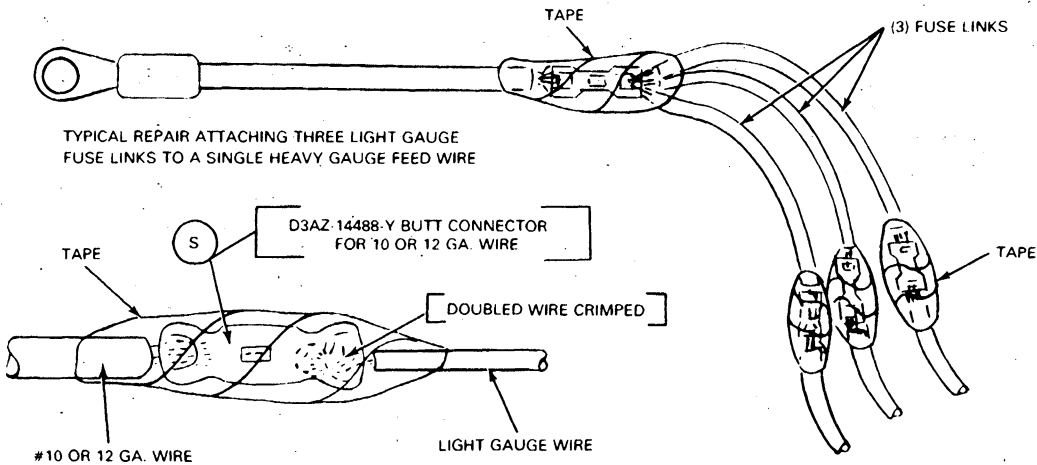
TYPICAL REPAIR USING THE SPECIAL #17 GA. (9.00" LONG-YELLOW) FUSE LINK REQUIRED FOR THE AIR/COND. CIRCUITS (2) #687E AND #261A LOCATED IN THE ENGINE COMPARTMENT



TYPICAL REPAIR FOR ANY IN-LINE FUSE LINK USING THE SPECIFIED GAUGE FUSE LINK FOR THE SPECIFIC CIRCUIT



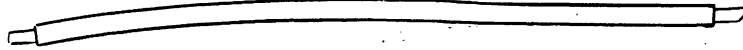
TYPICAL REPAIR USING THE EYELET TERMINAL FUSE LINK OF THE SPECIFIED GAUGE FOR ATTACHMENT TO A CIRCUIT WIRE END



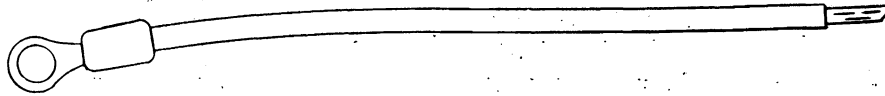
FUSIBLE LINK REPAIR PROCEDURE

J1704-2G

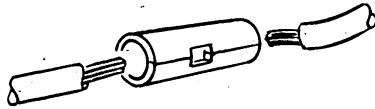
FIG. 4 Fuse Link Repair Procedure

**FUSE LINK AND BUTT CONNECTOR IDENTIFICATION****WIRING ASSEMBLY - FUSE LINK****(WITH INSULATION STRIPPED BOTH ENDS)**

D3AZ-14A526-H	NO.14 GA. WIRE - 9.00" $\pm$ .50 LENGTH (GREEN INSULATION)
D3AZ-14A526-J	NO.16 GA. WIRE - 9.00" $\pm$ .50 LENGTH (ORANGE INSULATION) AS REQ'D
D3AZ-14A526-K	NO.17 GA. WIRE - 9.00" $\pm$ .50 LENGTH (YELLOW INSULATION) AS REQ'D (SPECIAL USED WITH AIR CONDITIONING SYSTEM)
D3AZ-14A526-L	NO.18 GA. WIRE - 9.00" $\pm$ .50 LENGTH (RED INSULATION) AS REQ'D
D3AZ-14A526-M	NO.20 GA. WIRE - 9.00" $\pm$ .50 LENGTH (BLUE INSULATION) AS REQ'D

**WIRING ASSEMBLY - FUSE LINK****(WITH EYELET TERMINAL AND ONE END STRIPPED)**

D3AZ-14A526-D	NO.14 GA. WIRE - 9.00" $\pm$ .50 LENGTH (GREEN INSULATION) AS REQ'D
D3AZ-14A526-E	NO.16 GA. WIRE - 9.00" $\pm$ .50 LENGTH (ORANGE INSULATION) AS REQ'D
D3AZ-14A526-F	NO.18 GA. WIRE - 9.00" $\pm$ .50 LENGTH (RED INSULATION) AS REQ'D
D3AZ-14A526-G	NO.20 GA. WIRE - 9.00" $\pm$ .50 LENGTH (BLUE INSULATION) AS REQ'D

**BUTT CONNECTOR - WIRING SPLICE**

D3AZ-14488-Y	FOR NOS.10 AND 12 GA. WIRE (LOAD CIRCUIT) AS REQ'D
D3AZ-14488-Z	FOR NOS.14 AND 16 GA. WIRE (LOAD CIRCUIT) AS REQ'D

J1707-2E

**FIG. 5 Fuse Link and Butt Connector Identification**



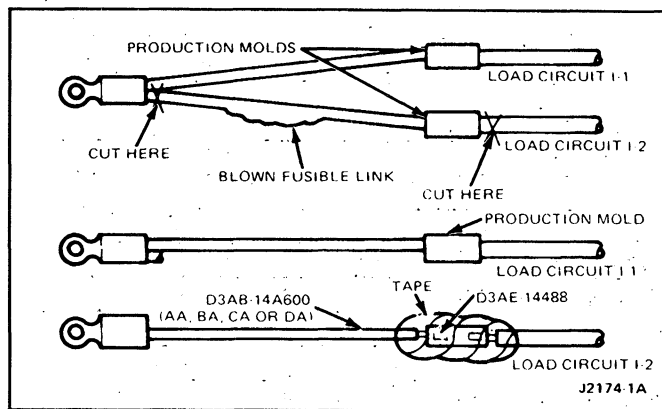
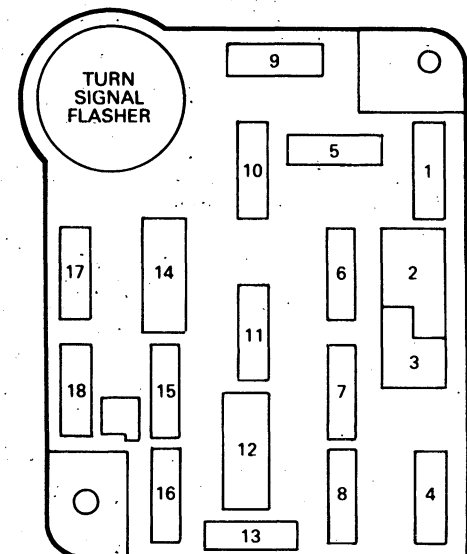


FIG. 6 Fusible Link Service Procedure

## SPECIFICATIONS

## E-150 — E-350 CIRCUIT PROTECTION FUSE PANEL

Fuse Protection	Amps	Fuse Color	Fuse Panel
1	15	Lt. Blue	Stoplamps, Hazard Flasher, Speed Control
2	7.5 C.B.		Windshield Wiper/Washer, Intermittent Wipers
3	Blank		
4	15	Lt. Blue	Instrument Panel Illumination, Running Lamps, Radio/Clock Illumination, Map Lamps, Heater and A/C Control Illumination
5	15	Lt. Blue	Turn Signal, Back-Up Lamps, Dual Battery Relay Coil
6	20	Yellow	Speed Control, Rear Cargo Lamp, Customer Convenience Plug Located Above Fuse Panel — Hot in RUN or ACCY
7	Blank		
8	15	Lt. Blue	Dome Lamp, 4.9L Cooling Fan Relay, Radio Memory, Power Door Lock Relays
9	15	Lt. Blue	A/C-Heater Blower Motor Relay Coil, A/C Clutch, Overdrive Cancel Switch
10	20	Yellow	Cigar Lighter
11	15	Lt. Blue	Radio and Clock, Premium Sound
12	30 C.B.		Power Door Locks
13	5	Tan	Instrument Panel Illumination Lamps
14	30		Power Windows
15	Blank		
16	15	Lt. Blue	Horn and Speed Control
17	Blank		
18	15	Lt. Blue	Instrument Panel Warning Lamps, 4.9L Cooling Fan Relay, Warning Buzzer, Fuel Pump



FUSE PANEL DIAGRAM — E-150 — E-350

CK11954-2B

## E-150 — E-350 NON-FUSE PANEL CIRCUIT PROTECTION

Circuit Protected	Type of Protection	Location
Ignition Switch and Fuse Panel Feed	16 Gauge Fuse Link	Near A/C Case
Headlamp Switch and Fuse Panel Feed	18 Gauge Fuse Link	Near A/C Case
Hego Sensor	20 Gauge Fuse Link	Near Master Cylinder
Ignition	20 Gauge Fuse Link	Near Master Cylinder
Blower Motor	20 Gauge Fuse Link	R.H. Fender Apron
Fuel Heater Diesel Engine	20 Gauge Fuse Link	R.H. Fender at Dash
Glow Plug Right Bank	14 Gauge Fuse Link	Starter Motor Relay
Glow Plug Left Bank	14 Gauge Fuse Link	Starter Motor Relay
Auxiliary A/C — Heater	18 Gauge Fuse Link	L.H. Fender at Dash

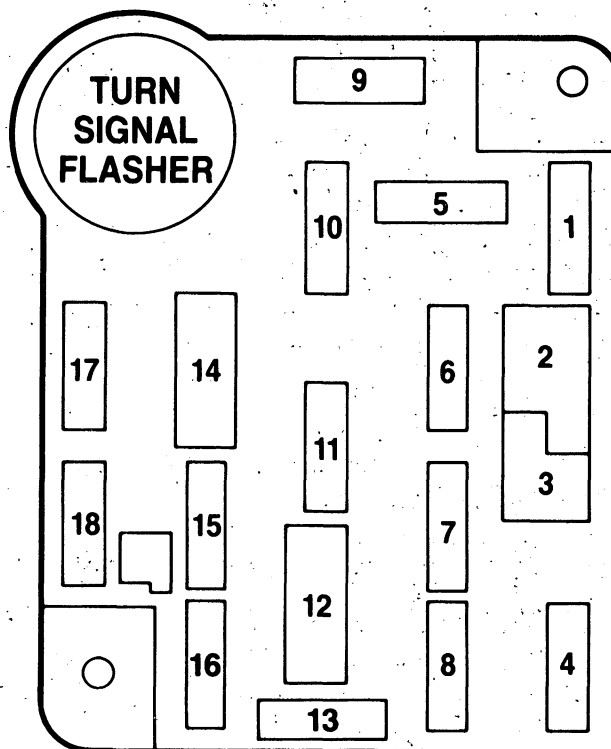
CK11955-2A

**F-150-F-350, F-SUPER DUTY AND BRONCO CIRCUIT PROTECTION  
FUSE PANEL**

Fuse Protection	Amps	Fuse Color	Circuits Protected
1	15	Lt. Blue	Stop/Hazard Lamps; Speed Control
2	—	—	(Not used)
3	—	—	(Not used)
4	15	Lt. Blue	Exterior Lamps; Instrument Illumination, Glove Box Lamp and Roof Map Lamp
5	15	Lt. Blue	Turn Lamps; Backup Lamps, Rear Window Defrost; Overdrive Transmission
6	15	Lt. Blue	Speed Control; Shift-on-the-fly; Cargo (Bronco)
7	—	—	(Not used)
8	15	Lt. Blue	Courtesy, Dome, Cargo Lamps (F-Series); Warning Buzzer
9	30	Lt. Green	Heater; A/C-Heater
10	5	—	Instrument Illumination; Clock Dimming
11	15	Lt. Blue	Radio; Headlight Switch; Clock Illumination
11	25	—	Tailgate Power Window; Power Mirrors
12	30 C.B.	—	Power Door Locks; Shift-on-the-fly
13	—	—	(Not used)
14	25 30 C.B.	Natural —	Tailgate Power Window Power Windows
15	10	Red	Auxiliary Fuel Tank Selector
16	30	Yellow	Horn; Cigar Lighter; Speed Control; 4.9L E.F.I. After Run Blower
17	20	Tan	Brake Anti-Lock
18	15	Lt. Blue	Seatbelt Buzzer; Warning Indicators; Tachometer; Diesel Glow Plug Control; Diesel Indicators

\*F-150-F-350 and F-Super Duty Only

\*\*Bronco Only



**FUSE PANEL DIAGRAM — F-150 — F-350, F-SUPER DUTY AND BRONCO**

CK6358-2E

Flashers	Location
Turn Signal Flasher	Front of fuse panel
Hazard Warning Flasher	Rear of fuse panel behind turn signal flasher

## FLASHER/LOCATION CHART

F-150-F-350, F-SUPER DUTY AND BRONCO  
NON FUSE PANEL CIRCUIT PROTECTION

Circuit Protected	Type of Protection	Location
Headlamp	22 amp C.B.	Integral w/lighting switch
Electric mirror	5 amp fuse (in-line)	On harness near fuse panel
Auxiliary battery	14 gauge fuse link	Near R.H. fender apron and dash panel
Alternator	16 gauge fuse link (for 40 or 60 amp alternators)	Starter motor relay
Alternator	14 gauge fuse link (for 70 amp alternator)	Starter motor relay
Trailer	16 gauge fuse link	Starter motor relay
Trailer	16 gauge fuse link	Starter motor relay
Trailer or auxiliary lamps	18 gauge fuse link	L.H. fender apron
Marker lamps		
Headlamp switch and fuse panel feed	16 gauge fuse link	Near R.H. fender apron and dash panel
Ignition switch and fuse panel feed	14 gauge fuse link (Bronco without ammeter) 16 gauge fuse link (F-150-F-350, F-Super Duty without ammeter) 14 gauge fuse link (with ammeter)	Near R.H. fender apron and dash panel
Windshield wiper/washer	C.B.	Integral w/wiper switch
Electronic engine controls	18 gauge fuse link	Starter motor relay
Heated backlite	16 gauge fuse link (Bronco)	L.H. fender apron

CK6379-2E

## SPECIAL SERVICE TOOLS

Model	Description
T67S-17018-A	Wire Fitting Crimping Tool

CK9042-1A

# AUXILIARY EQUIPMENT

## GROUP 35

SECTION TITLE	PAGE	SECTION TITLE	PAGE
ANTENNAS .....	35-11-1	RADIO AND PREMIUM SOUND SYSTEM .....	35-01-1
ASH RECEPTACLES AND CIGAR LIGHTER .....	35-40-1	SPEAKERS .....	35-31-1
HORNS .....	35-80-1	WINDSHIELD WASHERS .....	35-70-1
MIRRORS—INSIDE AND OUTSIDE .....	35-50-1	WINDSHIELD WIPERS—ELECTRIC .....	35-60-1

## SECTION 35-01 Radio and Premium Sound System

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd)	
Chassis Connectors .....	35-01-1	Radio (Cont'd)	
Operating Instructions .....	35-01-2	F-150 Through F-350 and F-Super Duty—	
Premium Sound System—Club Wagon .....	35-01-1	and Bronco .....	35-01-4
Radio .....	35-01-1	Premium Sound System Amplifier	
DIAGNOSIS AND TESTING		E-150—E-350 .....	35-01-6
Radio Reception .....	35-01-2	Radio Suppression Equipment .....	35-01-6
DIAGNOSIS GUIDES .....	35-01-6	SPECIAL SERVICE TOOLS .....	35-01-20
REMOVAL AND INSTALLATION		VEHICLE APPLICATION .....	35-01-1
Radio .....	35-01-4		
E-150—E-350 .....	35-01-5		

### VEHICLE APPLICATION

All E-150-E-350, F-150-F-350, F-Super Duty and Bronco.

### DESCRIPTION AND OPERATION

#### Radio

Refer to Fig. 1.

The electronic AM radio is standard on all models. An electronic AM/FM/MPX and electronic AM/FM/MPX/cassette radio is optional. A premium sound amplifier is included with the AM/FM/cassette radio option on E-Series Club Wagon.

### Premium Sound System—Club Wagon

The premium sound system includes an AM/FM/cassette, premium speakers and a separate power amplifier which increases the sound level and fidelity from the speakers. The premium sound system is on whenever the radio is turned on.

The amplifier is installed in the center instrument panel speaker opening. The premium sound system uses unique wiring to provide separate return wires to each speaker.

#### Chassis Connectors

The antenna lead-in receptacle is located on the back of the radio at the lower RH corner. The power and speaker leads are located on the back side of the radio at the LH corner.

## Operating Instructions

### ELECTRONIC AM RADIO (1 through 5)

### ELECTRONIC AM/FM STEREO RADIO (1 through 11)

### ELECTRONIC AM/FM CASSETTE STEREO RADIO (1 through 16)

1. **ON/OFF/VOLUME/CLOCK CONTROL**—Rotate to turn on radio and increase volume.  
Push to change display mode or push and hold to set time (see clock instructions).
2. **TUNE**—Push and quickly release to tune up(+) or down(-) one channel. Push and hold to tune rapidly across the band.
3. **FREQUENCY/CLOCK DISPLAY**—Indicates station frequency or time (refer to clock instructions).
4. **TONE**—Single tone control on AM radio. Rotate clockwise to emphasize treble or counterclockwise to emphasize bass.
  - Separate bass/treble controls on AM/FM stereo radios. Rotate control clockwise to increase, or counterclockwise to decrease bass/treble.
5. **PUSHBUTTON MEMORY**—To store a station, depress memory button and hold 4 seconds (sound will disappear and return). To recall a station, depress memory button and quickly release.
6. **SEEK**—Seek up or down band to next station.
7. **L/D**—(Local/Distant) Toggles between local and distant mode. Only displays LOC when in local mode (distant mode not displayed). Local mode is for use in metropolitan areas and allows capture of strong signal stations with seek control.
8. **AM**—Pushing AM activates AM mode. AM will be displayed. Six AM stations can be stored in memory.
9. **FM**—Pushing FM activates FM mode. Pushing FM again will toggle between FM1 and FM2. Twelve FM stations can be stored in memory (six in each of FM1 and FM2). FM1 or FM2 will be displayed.
10. **BALANCE**—Adjusts sound between LH and RH side of vehicle.
11. **FADE**—Adjusts sound between front and rear of vehicle.  
NOTE: The fader control is not present on some vehicles without rear speakers.
12. **DOLBY®**—Press when playing tapes recorded using the Dolby® system. Press again to deactivate.
13. **REVERSE**—Press to change the side of the cassette tape being played.
14. **FAST FORWARD**—Press to quickly advance the tape being played.
15. **FAST REWIND**—Press to quickly rewind the tape being played.

16. **EJECT**—Press to eject cassette.

## CLOCK CONTROLS ON ELECTRONIC RADIOS

The electronic radios have a built in clock. The radio display can be in either a clock or radio mode.

When the radio is off the radio display is in the clock mode continuously and time will be indicated.

When the radio is on the display can be in the radio or the clock mode. Pushing the volume control will switch the display mode from clock to radio or radio to clock as desired.

While in the clock mode, activating any of the radio tuning controls (tune, memory, seek) will change the display to radio frequency. After approximately 10 seconds the display will revert back to the clock display.

**SETTING THE CLOCK TIME**—Push and hold in the radio volume control and use the tune control to set the time.

Pushing on the left side (-) of the tune control sets hours and pushing on the right side (+) sets minutes. Releasing the volume control after setting the time automatically sets the seconds to zero (although seconds are not displayed).

## DIAGNOSIS AND TESTING

### Radio Reception

#### Antenna Position

If adjustable, adjust the antenna to full height (E-150—E-350).

#### Tuning

The electronic radio automatically tunes to the center of station frequency.

FM multiplex has a range of about 32 km (20 miles) before reception noises are heard. This means that in problem areas with tall buildings or hills it is necessary to select the strongest possible station.

Experience will dictate which FM stations offer the best reception.

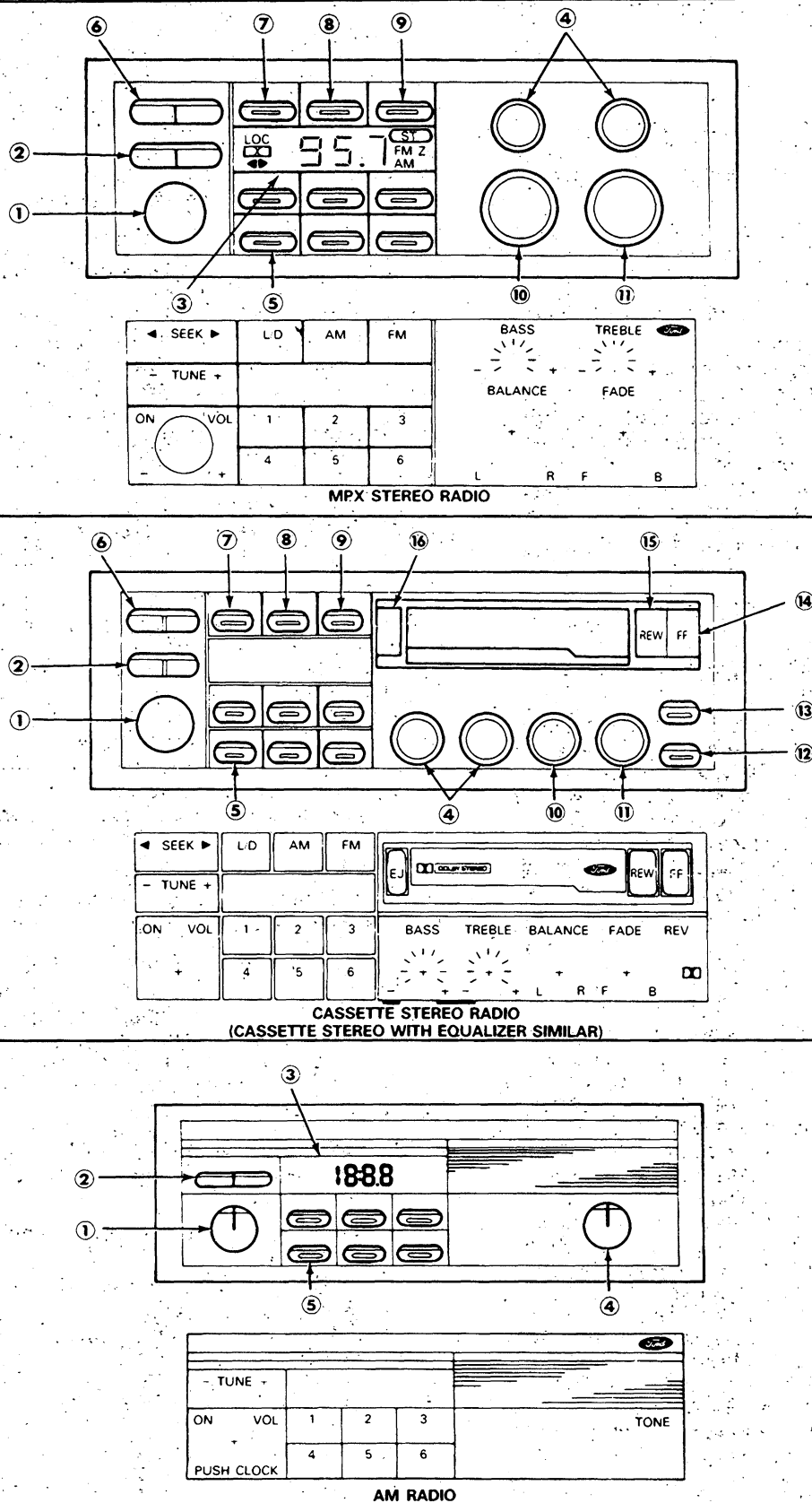
#### Tone Control

Turn the single tone control on AM radios clockwise to decrease bass (low frequencies) and turn counterclockwise to decrease the treble (high frequencies).

Refer to Operating Instructions for AM-FM radio tone control adjustment procedure.

#### Interfering Noises

Located within a few feet of the radio is the powerful electrical ignition system. The high voltage of this system produces noisy side effects that can interfere with both the AM and FM stations. Although precautions have been taken to minimize ignition noise, a certain amount can be heard on FM when the station is not quite tuned. Ignition noise from passing vehicles can occasionally be heard if they do not have proper suppression equipment installed. These same vehicles produce interference in television sets. Very little can be done with the radio receiver to protect against this type of external interference.



K9050-2C

FIG. 1 Radio Control Functions—Econoline, Bronco, (F-150—F-350 and F-Super Duty Similar)

Noise or static may result from many causes. Two of the most common sources of radio noise are listed below.

#### Ignition Noise:

The most effective method of evaluating ignition noise is to compare the radio performance with engine on, versus engine off. If ignition noise is present with engine running:

- Check to see that the spark plug wires are the suppresser-type and that the spark plugs are the correct resistor-type.
- Check to see that the carbon center insert in distributor cap is secure.
- Check distributor cap and rotor electrodes for silicone grease as this may cause ignition noise on FM or CB. This noise is characterized by a "motor boat"-type sound on weak to moderate strength stations. The noise can only be eliminated by replacing the distributor cap and rotor with a cap and rotor that does not have grease.

NOTE: Silicone grease must not be removed from cars equipped with electronic engine controls.

#### Missing or Faulty Noise Suppression Components:

- Noise suppression components may be faulty or missing.
- Check bond strap grounding effectiveness by wedging a large file between metal parts to ensure proper ground, such as between the tailpipe and body, or between the fender and frame, while the radio is playing and the engine is running. Listen for a decrease in the objectionable radio noise. If a reduction in radio noise is noted, first try tightening body and exhaust system clamps and brackets. Then, if necessary, install a new bond strap between the two metal parts to ensure proper ground.

#### FM Flutter

Flutter can best be described as repeated pops and hissing bursts heard in the speaker during an otherwise good broadcast. Usually this condition exists while traveling in the fringe area of the station. Flutter will become more severe within 40 km (25 miles) or less of the station. The signal loss becomes greater as distance from the station increases. Finally, reception is no longer possible. Flutter may also be noticed near the station because of the "line-of-sight" characteristic of FM radio waves. This condition can happen when a building or large structure is between the radio receiver and the station you are trying to receive. Some of the FM signal "bends" around the building, but certain spots have almost no signal. Some of these signal losses are only a few inches wide and if the vehicle is parked in one of these "dead spots" only noise is heard from the speaker. As the vehicle moves out of the shadow of the structure, the station will return to normal. Flutter will not occur on AM.

#### FM Multi-Path Cancellation

Another effect caused by the "line-of-sight" characteristic is called cancellation. This condition exists when the radio waves are reflected from objects or structures. The noises produced by cancellation are similar to flutter, with the addition of distortion in the program. A more familiar description of cancellation is

its similarity to the multiple ghosts and picture jumping that occur on television when a low flying plane passes. The same condition exists in the vehicle, except that the vehicle is moving and the reflecting structure is stationary. The reflected signal cancels the normal signal, causing the antenna to pick up noise and distortion. Cancellation effects are most prominent in metropolitan areas, but can also become quite severe in hilly terrain and depressed roadways.

#### FM Capture and Overloading

FM capture is an unusual condition that occurs when traveling in the vicinity of a broadcast tower. When tuned to a weak FM station, and passing a broadcast tower, a stronger station is received without changing the displayed frequency. When passing the tower, the station may switch back and forth a few times before returning to the station originally tuned. When several broadcast towers are present (common in metropolitan areas) several stations may overload the receiver resulting in considerable station changing, mixing and distortion. Fortunately this condition is localized and it will not harm the receiver. Some overloading may also be noticed on AM, but usually to a lesser degree.

#### Receiving FM Multiplex

Because more data is carried in the FM multiplex waves than in the monaural FM broadcasts, flutter, cancellation and capture are even more noticeable. The FM Multiplex noise-free broadcast range is approximately 8 km (5 miles) less than that received with the monaural FM radio. The AM/FM, FM Multiplex radio may never encounter any of these troublesome problems, as they are more prominent in metropolitan areas, hilly terrain and depressed roadways. However, when diagnosing FM Multiplex, it is recommended to accurately tune to the strongest FM Multiplex station.

#### Stereo Indicator Inoperative or Flickering (AM and FM Reception are OK)

- Verify that the customer is listening to stereo stations.
- A weak or distant signal may cause the stereo indicator to flicker. Tune the radio to a nearby FM stereo station. If reception is good, but the stereo indicator lamp is still intermittent, remove the radio chassis for service.

#### Tape Player will not Accept Cassette, Eats Tape, Plays too Fast or too Slow, etc. (AM and FM Operating Properly)

- Check operation of the tape player by using a known good cassette.
- If the condition is not corrected by the substitution of a known good cassette, the radio chassis must be removed and sent to an authorized service facility for service.

## REMOVAL AND INSTALLATION

### Radio

#### F-150 Through F-350 and F-Super Duty—and Bronco

Refer to Fig. 2.

#### Removal

1. Disconnect the battery ground cable.
2. Remove bezel.

3. Remove screws securing radio mounting bracket to instrument panel and pull out the radio chassis.
4. Disconnect the antenna lead-in cable, speaker wires and radio power wire.

### Installation

If radio is being replaced, transfer support to new radio.

1. Connect the antenna lead-in cable, speaker wires and feed (power) wires to the radio.
2. Position the radio in the instrument panel and secure with screws.
3. Position the bezel to the opening, and install.
4. Connect the battery ground cable.

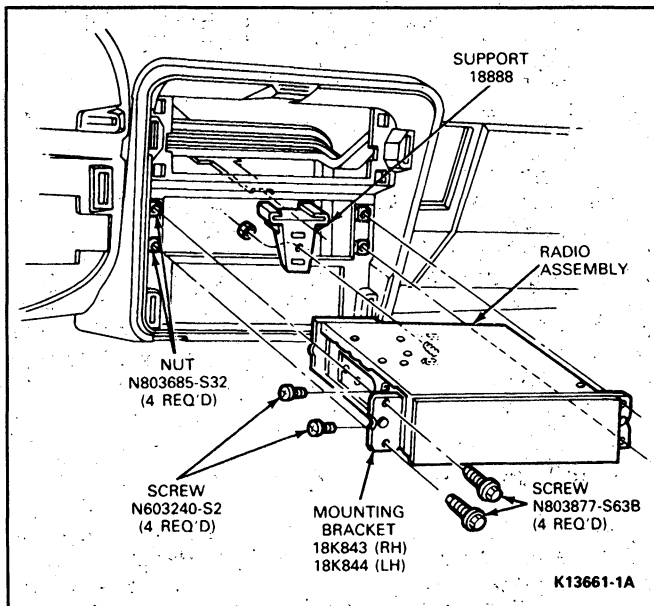


FIG. 2 Radio Installation F-Series Bronco

5. Check the radio operation.

### E-150—E-350

Refer to Fig. 3.

### Removal

1. Disconnect the battery ground cable from the battery.
2. Remove the heater and A/C control knobs.
3. Remove cigar lighter, if so equipped.
4. If equipped with cigar lighter, snap out the name plate (RH side of panel) to gain access to one panel attaching screw and remove the screw.
5. Remove the remaining finish panel attaching screws (five).
6. Being careful not to mar or scratch the instrument panel, insert a screwdriver or similar tool and pry (pop out) the cluster panel at two locations.
7. Remove the front radio-to-instrument panel attaching screws (four) and remove the radio.
8. Disconnect the antenna lead-in cable speaker connectors and radio (power) wire.

### Installation

1. Connect the radio antenna lead to the radio and speaker and power wires to the connectors.
2. Position the radio to the instrument panel and install the four attaching screws (front of radio).
3. Position the RH finish panel to the instrument panel (snap-in) and the two retaining clips.
4. Install the finish panel attaching screws and name plate, if removed.
5. Install the cigar lighter assembly if removed.
6. Install the heater and A/C control knobs.
7. Connect the battery ground cable.
8. Check the operation of the antenna.

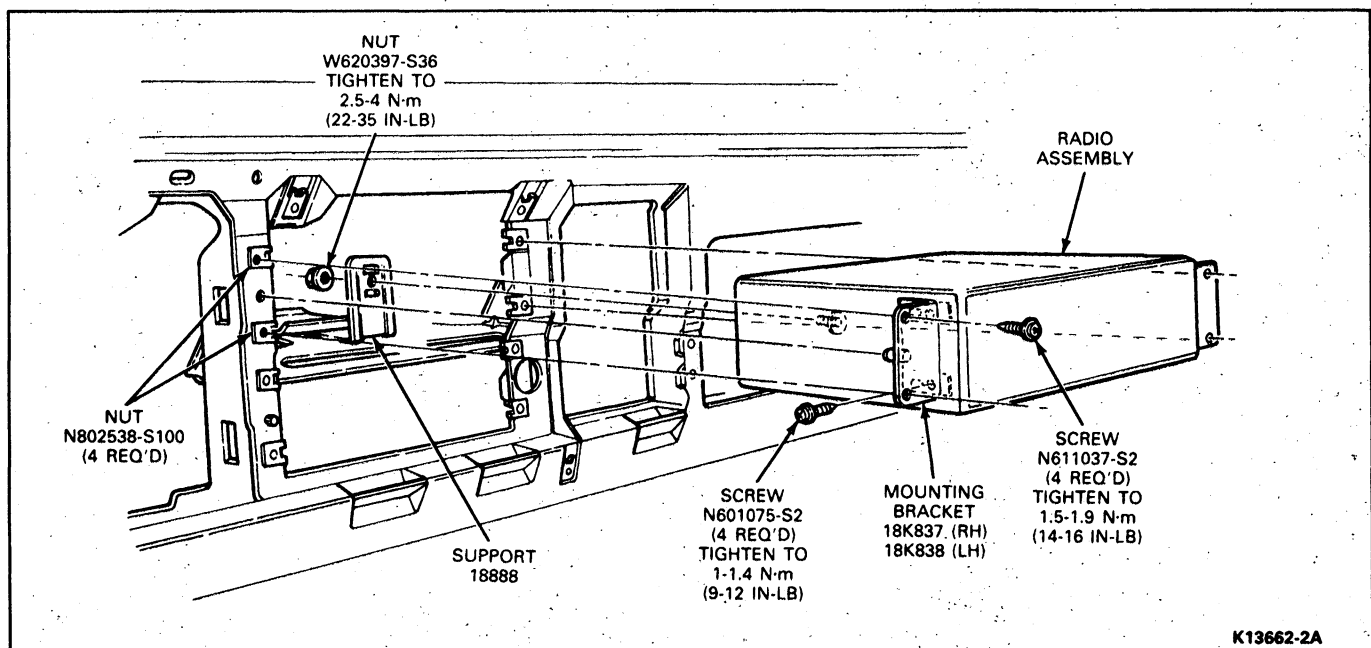


FIG. 3 Radio Installation E-Series



**Premium Sound System Amplifier E-150—E-350**

Refer to Fig. 4.

**Removal**

1. Remove center instrument panel speaker cover.
2. Disconnect amplifier wiring harness connections under RH side of instrument panel.
3. Remove two nuts holding amplifier to speaker cover and remove amplifier.

**Installation**

1. Position amplifier on speaker cover.
2. Install retaining nuts and tighten to 1.1-1.5 N·m (10-13 in-lb).
3. Connect amplifier wiring connector.
4. Install speaker cover and retaining screws.
5. Check operation of amplifier.

**Radio Suppression Equipment**

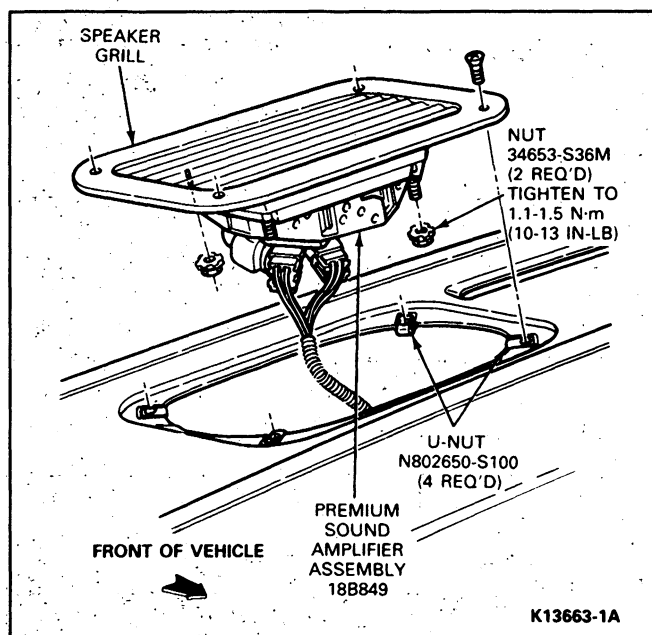
The radio suppression equipment used on the different models is shown in Figs. 7 through 10. When replacing any radio suppression equipment components, be sure that a good contact is made at all attachments. Remove any paint or dirt from between a condenser and its ground. Tighten all nuts and bolts securely.

**Tape Player Performance**

If weak or wavering sound is encountered, it is suggested that the player be checked by using a tape of known quality. If the tape cartridge is ruled out as the cause, routine cleaning may restore normal operation.

**Periodic Cleaning of Tape Player**

Over a period of time, the playback head, capstans and pinch rollers gather an oxide residue from the tape as it passes these components while playing. Oxide accumulation can cause weak or wavering sound and damage to the cassette tape and player.



**FIG. 4. Amplifier Installation—E-Series**

It is recommended, for best performance, that the player be cleaned every 10 to 12 hours of playing time using a Ford cassette player cleaning cartridge available at your Ford or Lincoln-Mercury dealer. The use of other cleaning cassette products is not recommended, as these could cause damage to player or cassette tapes.

**DIAGNOSIS GUIDES**

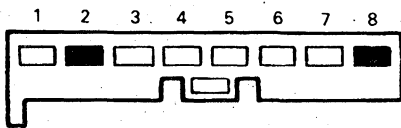
Use the following guides, along with a radio tester, to diagnose and repair the radio system. Refer to Figs. 5 and 6 when performing Premium Sound system diagnosis. Testing can be performed using Rotunda Volt-Ohm Meter 007-00001 or equivalent.

## RADIO HAS WEAK RECEPTION

TEST STEP		RESULT	ACTION TO TAKE
1.0	DURING SYSTEM CHECK RADIO RECEPTION IS WEAK		
1.1	CHECK RADIO RECEPTION		
	<ul style="list-style-type: none"> <li>Extend antenna to maximum height (if so equipped) and position vehicle in an open area away from steel buildings.</li> <li>Check radio reception by counting the number of stations received and compare to the known properly functioning radio system station count.</li> </ul>	Good radio reception →  Poor radio reception →	Radio operating properly.  GO to 1.2.
1.2	CHECK ANTENNA CONNECTIONS		
	<ul style="list-style-type: none"> <li>Check antenna connections and clean or tighten as required.</li> <li>Check radio reception.</li> </ul>	Good radio reception →  Poor radio reception →	Radio operating properly.  GO to 1.3.
1.3	RE-CHECK ANTENNA		
	<ul style="list-style-type: none"> <li>Check antenna system using appropriate diagnostic procedures.</li> </ul>	Procedure shows antenna needs repair →  Procedure shows antenna is OK →	REPAIR antenna system as required. CHECK operation of radio.  Have radio chassis repaired by authorized service center.

CK5324-2B

## RADIO POWER CONNECTORS







	ALL RADIOS		
	Pin No.	Circuit No.	Function
	2, 8	—	Not Connected
	7	747	At Output/Sense <sup>①</sup>
	6	694	Radio Ground <sup>②</sup>
	5	484	Display Back Lighting
	4	19	Radio Graphics Lighting
	3	137	Radio Power (B+)
	1	54	Radio Memory (A+)

① Used with premium sound only

② Not required on Econoline





CK10464-2A

## RADIO IS INOPERATIVE OR INTERMITTENT

TEST STEP		RESULT	ACTION TO TAKE
2.0	DURING RADIO CHECK, THE RADIO OPERATES INTERMITTENTLY OR IS INOPERATIVE		
2.1	CHECK RADIO OPERATION		
	<ul style="list-style-type: none"> <li>Check operation of radio to determine fault.</li> </ul>	Radio is inoperative	GO to 2.2.
		Radio is intermittent	GO to 2.3.
2.2	CHECK FUSE		
	<ul style="list-style-type: none"> <li>Check radio fuse.</li> </ul>	Fuse is 	GO to 2.3.
		Fuse is 	GO to 2.4.
2.3	CHECK POWER FEED		
	<ul style="list-style-type: none"> <li>Check power feed for proper connection.</li> </ul>	Connection 	GO to 2.5.
		Connection 	CONNECT power feed cable correctly. RE-CHECK radio for proper operation.
2.4	REPLACE FUSE		
	<ul style="list-style-type: none"> <li>Turn ignition switch and radio to OFF.</li> <li>Replace fuse.</li> <li>Turn on ignition switch only.</li> <li>Recheck fuse.</li> </ul>	Fuse 	TURN ignition to OFF. Determine location of powerfeed to radio. REPAIR or REPLACE damaged wiring as required. REPLACE fuse.
		Fuse 	Operate radio and tape player. If fuse fails again have radio chassis serviced by an authorized service center. If fuse is still OK, radio is now operational.
2.5	CHECK POWER TO RADIO		
	<ul style="list-style-type: none"> <li>Using a test light or Rotunda Model 007-00001 Digital Volt-Ohmmeter or equivalent, check power to radio.</li> </ul>	Radio has power	GO to 2.6.
		Radio has no power	REPLACE or REPAIR harness as required.
2.6	CHECK GROUND CIRCUIT		
	<ul style="list-style-type: none"> <li>Using a DVOM or self-powered test lamp, check continuity of circuit 694.</li> </ul>	Continuity in circuit 694	GO to 2.7.
		No continuity in circuit 694	SERVICE ground circuit
2.7	CHECK SPEAKERS		
	<ul style="list-style-type: none"> <li>Is problem present on all speakers?</li> </ul>	Problem present on all speakers	GO to 2.8.
		Problem not present on all speakers	GO to 2.9.










CK6740-2C

## RADIO IS INOPERATIVE OR INTERMITTENT (Cont'd.)

TEST STEP		RESULT	ACTION TO TAKE
2.8	CHECK ANTENNA		
<ul style="list-style-type: none"> <li>Check antenna system using appropriate diagnostic procedures.</li> </ul>		Antenna system 	GO to 2.9.
		Antenna system 	CONNECT, REPAIR, or REPLACE antenna components as required.
2.9	CHECK RADIO CHASSIS		
<ul style="list-style-type: none"> <li>Check radio chassis using known good speaker connected directly to radio chassis.</li> </ul>		Reception 	REPLACE speaker or CONNECT, REPAIR, or REPLACE speaker wiring as required.
		Reception 	Have radio chassis REPAIRED by authorized service center.

CK6741-2B

**NOISY AM RECEPTION — ENGINE RUNNING, VEHICLE IN OR NOT IN MOTION**

<b>TEST STEP</b>		<b>RESULT</b>	<b>ACTION TO TAKE</b>
<b>3.0</b>	<b>DURING CHECK, AM RADIO RECEPTION NOISY WITH ENGINE RUNNING</b>		
<b>3.1</b>	<b>CHECK ANTENNA CONNECTIONS</b>		
	<ul style="list-style-type: none"> <li>Check antenna connections including extension cable (if so equipped). Connections must be clean and secure.</li> </ul>	Connections are not clean and secure All connections 	CLEAN and/or SECURE antenna cable connections as required. GO to 3.2.
<b>3.2</b>	<b>CHECK ANTENNA MOUNTING</b>		
	<ul style="list-style-type: none"> <li>Check to make sure antenna is securely mounted to body at ground points. Contacts must be clean and metal-to-metal.</li> </ul>	Contacts  Contacts 	CLEAN and/or SECURE ground connections as required. GO to 3.3.
<b>3.3</b>	<b>CHECK SUPPRESSION EQUIPMENT</b>		
	<ul style="list-style-type: none"> <li>Check for presence of all required suppression equipment, body grounding strap usage, security, cleanliness and metal-to-metal connections.</li> </ul>	Connections are bad and/or suppression equipment not installed Connections are  and suppression equipment installed correctly	INSTALL or TIGHTEN and/or CLEAN connections as required. GO to 3.4.
<b>3.4</b>	<b>CHECK HOOD BONDING STRAP</b>		
	<ul style="list-style-type: none"> <li>Check hood bonding strap for excessive usage, secureness of mounting to sheet metal and contact with hood. Hood bonding strap must scratch hood paint.</li> </ul>	Strap  Strap 	INSTALL, SECURE, or FORM hood bonding strap as required. GO to 3.5.
<b>3.5</b>	<b>CHECK WIRES AND MOUNTING OF VOLTAGE REGULATOR CAPACITOR, IGNITION COIL CAPACITOR</b>		
	<ul style="list-style-type: none"> <li>Check the mounting and connecting wires of the voltage regulator capacitor and ignition coil capacitor (if so equipped) for secureness, cleanliness and metal-to-metal contact.</li> </ul> <p><b>IMPORTANT:</b> The capacitor mounting points are used to complete the electrical circuit and must be mounted securely to clean surfaces.</p>	Connections  Connections 	CLEAN and/or SECURE connections as required. GO to 3.6.
<b>3.6</b>	<b>CHECK OPERATION OF THE VOLTAGE REGULATOR CAPACITOR AND IGNITION COIL CAPACITOR</b>		
	<ul style="list-style-type: none"> <li>Check the operation of the voltage regulator capacitor and ignition coil capacitor by replacing with known good components.</li> </ul>	Voltage regulator capacitor and/or ignition coil capacitor bad Capacitor(s) are 	REPLACE capacitor(s) with known good component(s). GO to 3.7.

CK5326-2B









## NOISY AM RECEPTION — ENGINE RUNNING, VEHICLE IN OR NOT IN MOTION — CONTINUED

TEST STEP		RESULT	ACTION TO TAKE
3.7	CHECK ALTERNATOR		
	<ul style="list-style-type: none"> <li>Check alternator by disconnecting wiring harness from voltage regulator.</li> </ul>	Noise eliminated Noise still present	CHECK alternator as directed in Group 31. REPAIR or REPLACE as required. GO to 3.8.
3.8	CHECK SPARK PLUG WIRES		
	<ul style="list-style-type: none"> <li>Check spark plug wires for proper routing, grounding and secureness of connections.</li> </ul>	Spark plug wires not routed, grounded or secured Spark plug wires (OK)	REROUTE or REPLACE spark plug wires or SECURE connections as required. GO to 3.9.
3.9	CHECK IGNITION SYSTEM		
	<ul style="list-style-type: none"> <li>Check ignition system for proper operation. (Use ignition system analyzer or check for open spark plug wires using ohmmeter.) Also check spark plug for cracked insulators.</li> </ul>	Ignition system and/or spark plugs not OK Ignition system and spark plugs OK	REPAIR or REPLACE components as required. GO to 3.10
3.10	CHECK RADIO CHASSIS MOUNTING		
	<ul style="list-style-type: none"> <li>Check all radio chassis mounting points for secureness, cleanliness and metal-to-metal contact.*</li> </ul>	Mounting (OK) Mountings (OK)	CLEAN and/or SECURE as required. GO to 3.11.
3.11	SUBSTITUTE A KNOWN GOOD SPEAKER AND ANTENNA		
	<ul style="list-style-type: none"> <li>Substitute a known good speaker, antenna and antenna extension cable (if so equipped). Be sure to ground antenna to an unpainted metal surface.</li> </ul>	Noise eliminated Noise not eliminated	REPAIR or REPLACE antenna, speaker or antenna extension cable. GO to 3.12.
3.12	SUBSTITUTE KNOWN GOOD RADIO		
	<ul style="list-style-type: none"> <li>Substitute known good radio.</li> </ul>	Noise eliminated Noise not eliminated	Have radio unit REPAIRED by authorized service center. GO to 3.13.
3.13	REPOSITION ANTENNA, SPEAKER OR RADIO POWER FEED		
	<ul style="list-style-type: none"> <li>Check to see if noise can be eliminated by repositioning antenna, speaker or radio power feed wires.</li> </ul>	Noise eliminated Noise not eliminated	REPOSITION permanently by taping. GO to 3.14.
3.14	GROUND VARIOUS PARTS OF TRUCK		
	<ul style="list-style-type: none"> <li>Ground various parts of the truck to the frame using a jumper cable. For example: engine, fenders, quarter panel, stone deflectors, air cleaner, body sheet metal.</li> </ul>	Noise eliminated	PROVIDE permanent ground where required.

\*F-Series/Bronco radios are grounded to the instrument panel through circuit no. 694 with an eyelet near the rear of the radio.


CK10465-2A

**NOISY FM RECEPTION — ENGINE RUNNING, VEHICLE NOT IN MOTION**

TEST STEP		RESULT	ACTION TO TAKE
<b>4.0</b>	<b>DURING CHECK, FM RADIO RECEPTION IS NOISY WHILE VEHICLE IS NOT IN MOTION</b>		
<b>4.1</b>	<b>NOISE IS ONLY ON FM STERO</b>		
	<ul style="list-style-type: none"> <li>Check to see if noise is only on FM stereo. Determine if customer concern is due to FM stereo reception limitation. Refer to normal operation description.</li> </ul>	Noise only on FM stereo ►  Noise is on both FM stereo and FM mono ►	EXPLAIN and DEMONSTRATE to customer. Inform customer of methods for obtaining best reception.  GO to 4.2.
<b>4.2</b>	<b>CHECK ANTENNA CABLE CONNECTIONS</b>		
	<ul style="list-style-type: none"> <li>Check antenna cable connections including extension cable (if so equipped). Connections must be clean and secure.</li> </ul>	Connections  ►  Connections  ►	CLEAN and/or SECURE as required.  GO to 4.3.
<b>4.3</b>	<b>CHECK ANTENNA MOUNTING</b>		
	<ul style="list-style-type: none"> <li>Check to ensure antenna is securely mounted to body at mounting nut above antenna; and also, ensure that prongs of grounding collar, at fender underside, are contacting metal. Contact must be clean and metal-to-metal.</li> </ul>	Connections  ►  Connections are  ►	CLEAN and/or SECURE as required.  GO to 4.4.
<b>4.4</b>	<b>CHECK DISTRIBUTOR ROTOR</b>		
	<ul style="list-style-type: none"> <li>Check for adequate distributor rotor contact spring tension. Height of spring should be 8.9 mm (0.35 in.) from top of rotor (not applicable to recreational vehicles).</li> </ul>	Spring tension  ►  Spring tension  ►	REPLACE rotor.  GO to 4.5.
<b>4.5</b>	<b>CHECK DISTRIBUTOR CAP</b>		
	<ul style="list-style-type: none"> <li>Check to see if carbon center insert in distributor cap is secure.</li> </ul>	Carbon center not secure ►  Carbon center  ►	REPLACE distributor cap.  GO to 4.6.
<b>4.6</b>	<b>CHECK SPARK PLUG WIRES</b>		
	Check spark plug wires for proper routing and secureness of connections.	Routing and/or connections  ►  Routings and connections good ►	REROUTE or SECURE connections as required.  GO to 4.7.

CK5327-2D

## NOISY FM RECEPTION — ENGINE RUNNING, VEHICLE NOT IN MOTION — CONTINUED



TEST STEP		RESULT	ACTION TO TAKE
4.7	CHECK IGNITION SYSTEM		
	<ul style="list-style-type: none"> <li>Check ignition system for proper operation. (Use ignition system analyzer or check for open spark plug wires using ohmmeter). Also check spark plug for cracked insulators.</li> </ul>	Ignition system and/or spark plug wires not working properly, and/or spark plug insulators cracked Ignition system, spark plug wires and spark plugs in good condition	REPAIR or REPLACE components as required. GO to 4.8.
4.8	CHECK RADIO CHASSIS MOUNTING		
	<ul style="list-style-type: none"> <li>Check all radio chassis mounting points for secureness, cleanliness and metal-to-metal contact.</li> </ul>	Contacts are not secure or clean Contacts are 	CLEAN and/or SECURE as required. GO to 4.9.
4.9	SUBSTITUTE A GOOD SPEAKER AND ANTENNA		
	<ul style="list-style-type: none"> <li>Substitute a known good speaker and antenna being sure to ground antenna base to unpainted metal surface.</li> </ul>	Noise eliminated Noise not eliminated	REPAIR or REPLACE antenna or speaker. GO to 4.10.
4.10	SUBSTITUTE EXTENSION CABLE		
	<ul style="list-style-type: none"> <li>If equipped with antenna extension cable, substitute with a known good cable. (If not equipped with extension cable GO to 4.11.)</li> </ul>	Noise eliminated Noise not eliminated	REPLACE antenna extension cable. GO to 4.11.
4.11	SUBSTITUTE KNOWN GOOD RADIO		
	<ul style="list-style-type: none"> <li>Remove radio and substitute with a known good radio.</li> </ul>	Noise eliminated Noise not eliminated	Have radio unit REPAIRED by authorized service center. GO to 4.12.
4.12	REPOSITION ANTENNA, SPEAKER, OR RADIO FEED WIRES		
	<ul style="list-style-type: none"> <li>Check to see if noise can be eliminated by repositioning antenna, speaker or radio power feed wires.</li> </ul>	Noise eliminated Noise not eliminated	REPOSITION permanently by taping. REPLACE distributor cap and rotor with new ungreased cap and rotor.

\*F-Series/Bronco radios are grounded to the instrument panel through circuit no. 694 with an eyelet near the rear of the radio.

CK10466-2A







**NOISY RECEPTION — ENGINE RUNNING, VEHICLE IN MOTION**

TEST STEP		RESULT	ACTION TO TAKE
<b>5.0</b>	DURING CHECK, RECEPTION ON RADIO IS NOISY WITH ENGINE RUNNING AND VEHICLE IN MOTION		
<b>5.1</b>	VISUALLY INSPECT CONNECTIONS		
	<ul style="list-style-type: none"> <li>Inspect all connections to battery; antenna leads, speaker leads, and radio receiver.*</li> </ul>	Connections 	REPAIR or REPLACE wires as necessary.
		Connections 	GO to 5.2.
<b>5.2</b>	CHECK ANTENNA LEAD IN CABLE		
	<ul style="list-style-type: none"> <li>Check for loose antenna lead in cable or loose antenna.</li> </ul>	Antenna and/or cable are loose	CONNECT antenna and/or lead in cable securely.
		Antenna and cable secure	Have radio repaired by a qualified radio technician.

\*F-Series/Bronco radios are grounded to the instrument panel through circuit no. 694 with an eyelet near the rear of the radio.

CK10467-2A

**NOISY RECEPTION — ENGINE NOT RUNNING**

TEST STEP		RESULT	ACTION TO TAKE
<b>6.0</b>	DURING CHECK RADIO RECEPTION IS NOISY WHILE ENGINE IS NOT RUNNING		
<b>6.1</b>	VISUALLY CHECK FOR LOOSE CONNECTIONS		
	<ul style="list-style-type: none"> <li>Check all connections to battery, antenna leads, speaker lead and radio receiver for proper connection.*</li> </ul>	Connections 	REPAIR or REPLACE connections or wires as required.
		Connections 	GO to 6.2.
<b>6.2</b>	CHECK ANTENNA LEAD IN CABLE		
	<ul style="list-style-type: none"> <li>Check all antenna lead-in cables for bent or missing male pins. Also check the female connectors for position of receptacle with respect to the insulator. The receptacle should be visible.</li> </ul>	Connectors and/or connections 	REPLACE antenna lead in cables.
		Connections 	Have radio REPAIRED by a qualified radio technician.

\*F-Series/Bronco radios are grounded to the instrument panel through circuit no. 694 with an eyelet near the rear of the radio.

CK10468-2A

## PREMIUM SOUND

## NO SOUND FROM ONE OR MORE SPEAKERS, RADIO TURNED ON — PREMIUM SOUND IS OFF

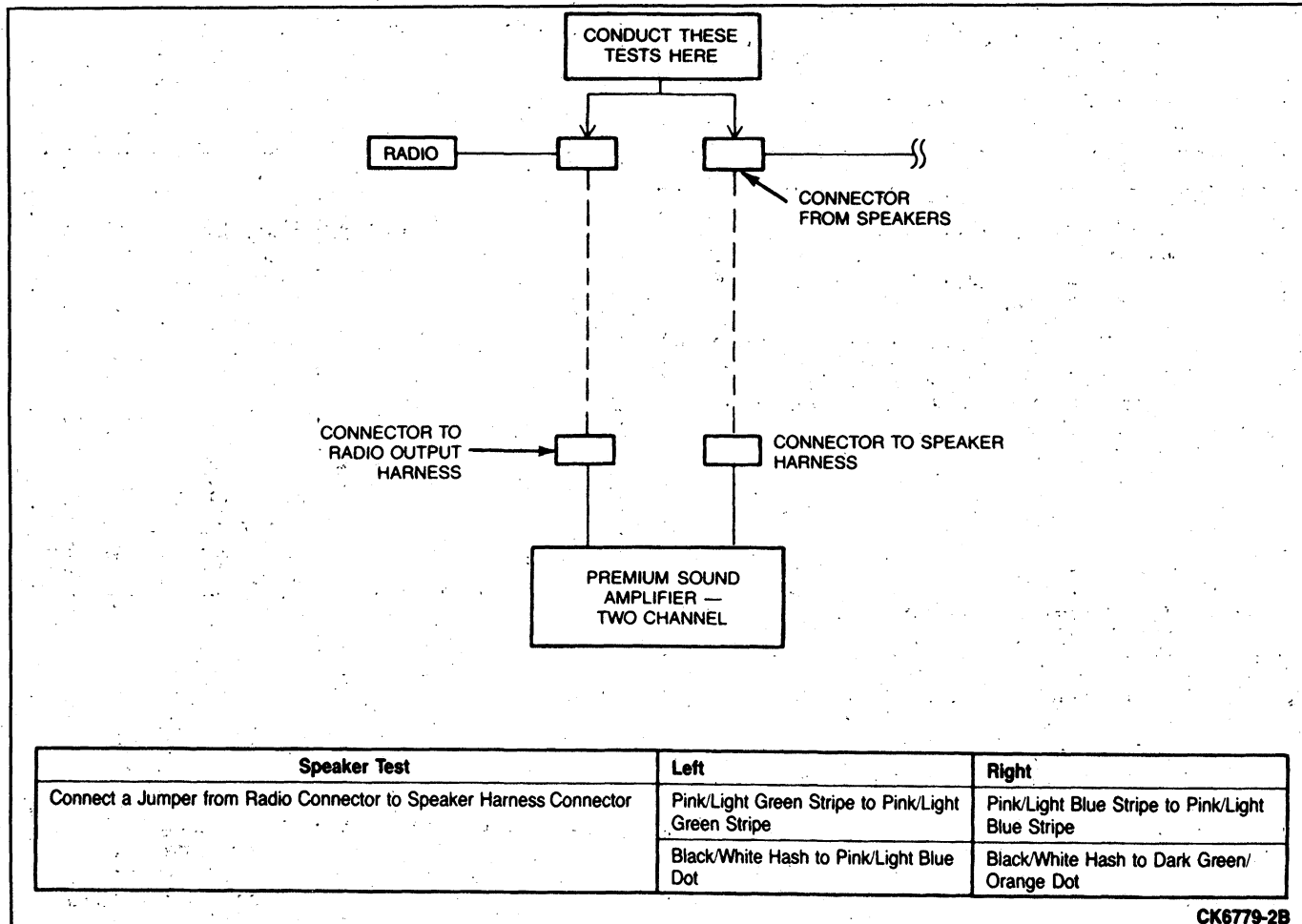
TEST STEP		RESULT	ACTION TO TAKE
<b>A.0</b> DURING SYSTEM CHECK WITH PREMIUM SOUND OFF AND RADIO TURNED ON THERE IS NO SOUND FROM ONE OR MORE SPEAKERS			
<b>A.1</b>	<b>BYPASS PREMIUM SOUND CIRCUITS</b>		
<ul style="list-style-type: none"> <li>• Bypass premium sound control circuits for the inoperative speakers as follows:               <ol style="list-style-type: none"> <li>1. Disconnect connectors between radio and premium sound amplifier and between speakers and premium sound amplifier.</li> <li>2. Connect jumper wires from radio to wiring harness for defective speaker.</li> <li>3. Check connector locations and wiring color codes.</li> </ol> </li> <li>• Test radio for sound from speaker(s).</li> </ul>		Speaker(s) work ►  Speaker(s) do not work ►	GO to <b>A.2</b> .  GO to <b>A.3</b> .
<b>A.2</b>		(OK) ►  (X) ►	REPLACE the premium sound amplifier.  Vehicle wiring is damaged. FOLLOW standard procedure for diagnosis and service of damage.
<b>A.3</b>	<b>CHECK OPERATION OF SPEAKER AND CHECK SPEAKER WIRING</b>		
<ul style="list-style-type: none"> <li>• Check operation of speaker, and vehicle wiring as follows:               <ol style="list-style-type: none"> <li>1. Connect jumper wire from a radio speaker harness that is working properly to the damaged speaker harness.</li> </ol> </li> </ul>		Speaker works ►  Speaker does not work ►	Radio is damaged. SEND radio to authorized service station for service.  Vehicle wiring or speaker is damaged. FOLLOW standard procedure for diagnosis and service of damage.

CK5331-2E

**PREMIUM SOUND SYSTEM**  
**NO PREMIUM SOUND FROM ONE OR MORE PREMIUM SOUND SPEAKERS — PREMIUM SOUND ON**  
**(NORMAL SOUND FROM ALL SPEAKERS WITH PREMIUM SOUND OFF)**

TEST STEP	RESULT	ACTION TO TAKE
<b>B.0</b> DURING CHECK THERE IS NO SOUND FROM ONE OR MORE SPEAKERS WITH PREMIUM SOUND ON (WITH PREMIUM SOUND OFF THERE IS NORMAL SOUND FROM SPEAKERS)		
<b>B.1</b> VERIFY CONDITION		
<ul style="list-style-type: none"> <li>Check for premium sound at each speaker.</li> </ul>	Premium sound at all speakers No premium sound at one or more speakers	System OK. REPLACE amplifier

CK5332-2C



CK6779-2B

FIG. 5 Premium Sound By-Passing Test (Two Channel Amplifier)—E-150—E-350

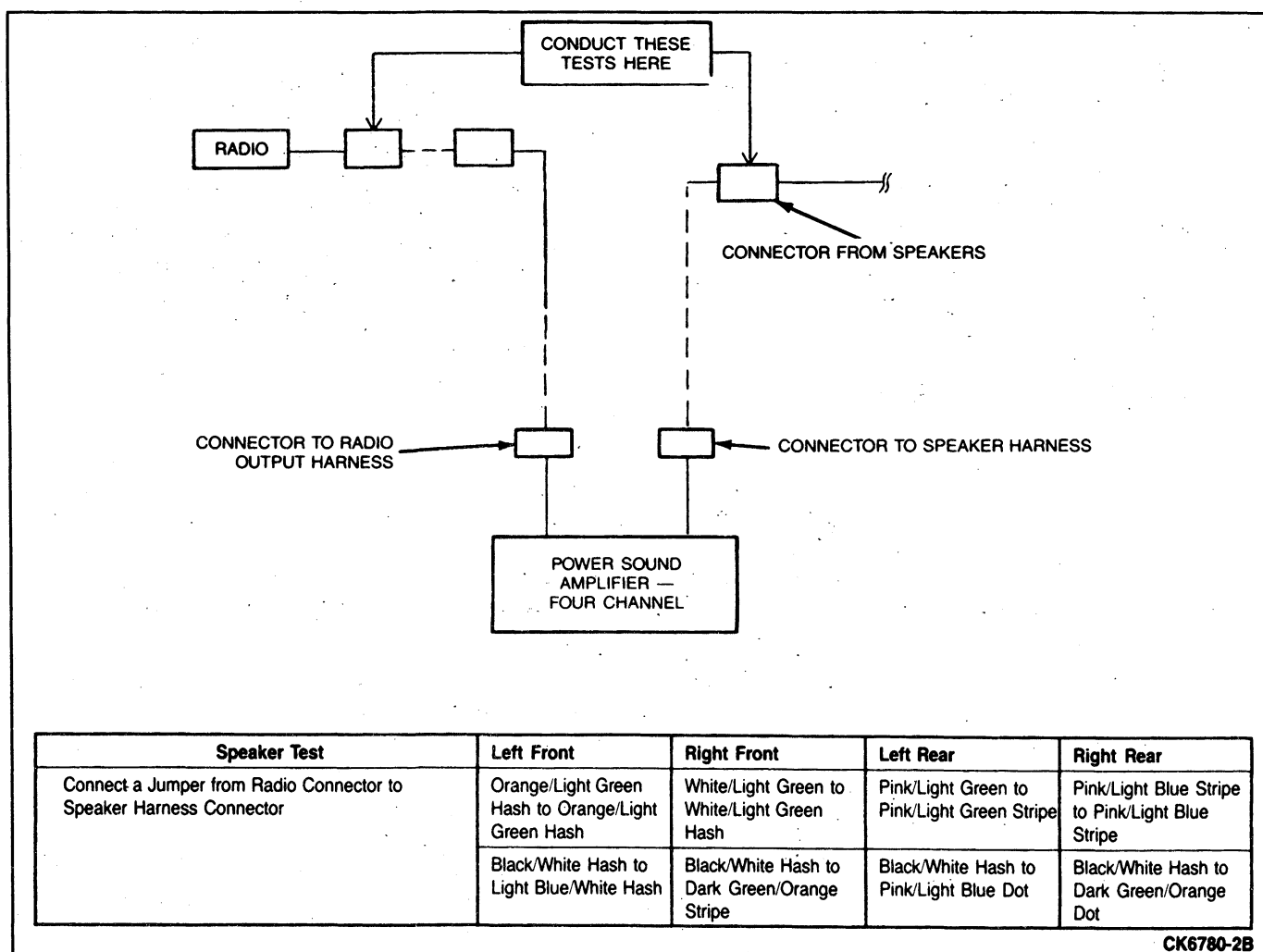


FIG. 6 Premium Sound By-Passing Test (Four Channel Amplifier)

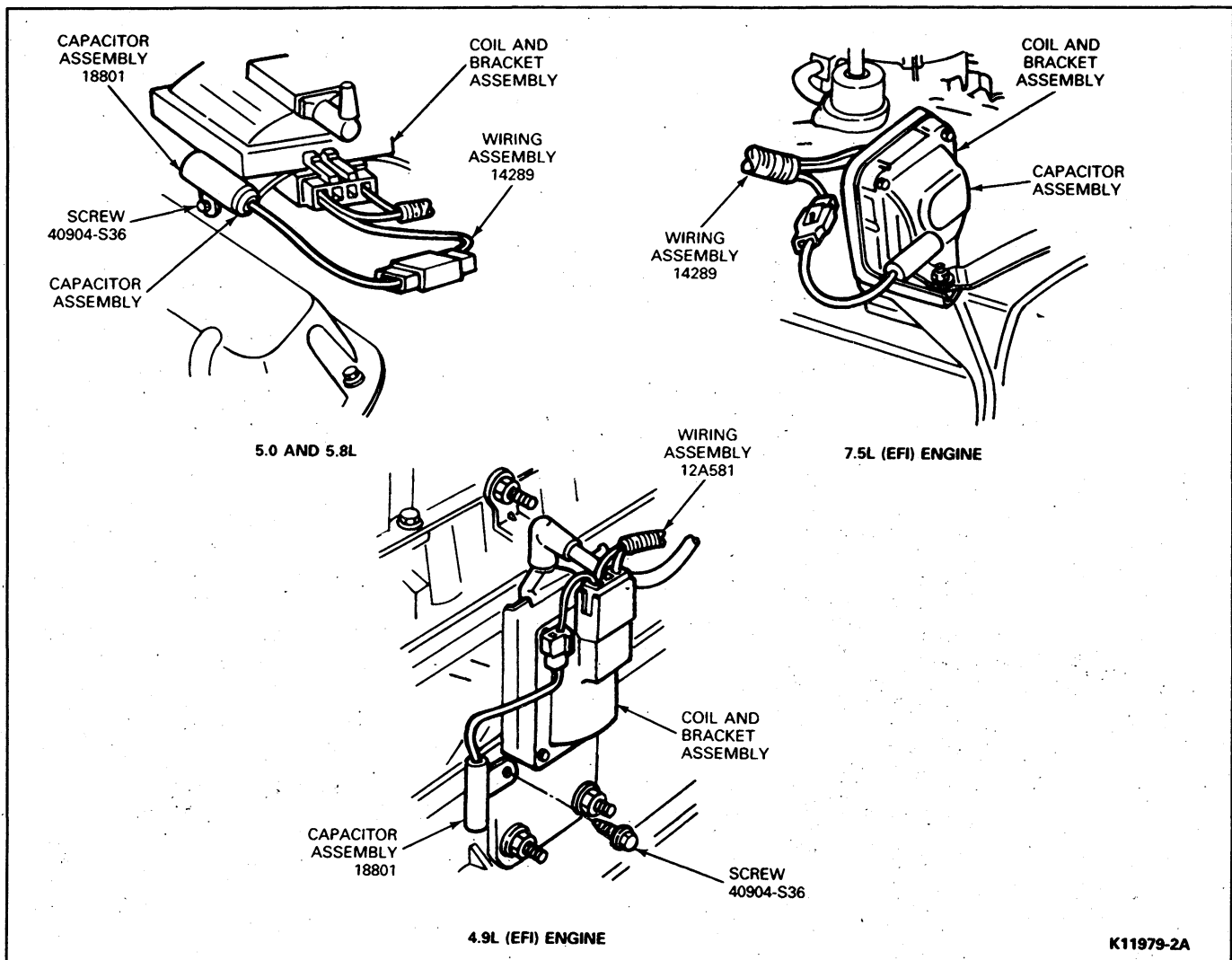
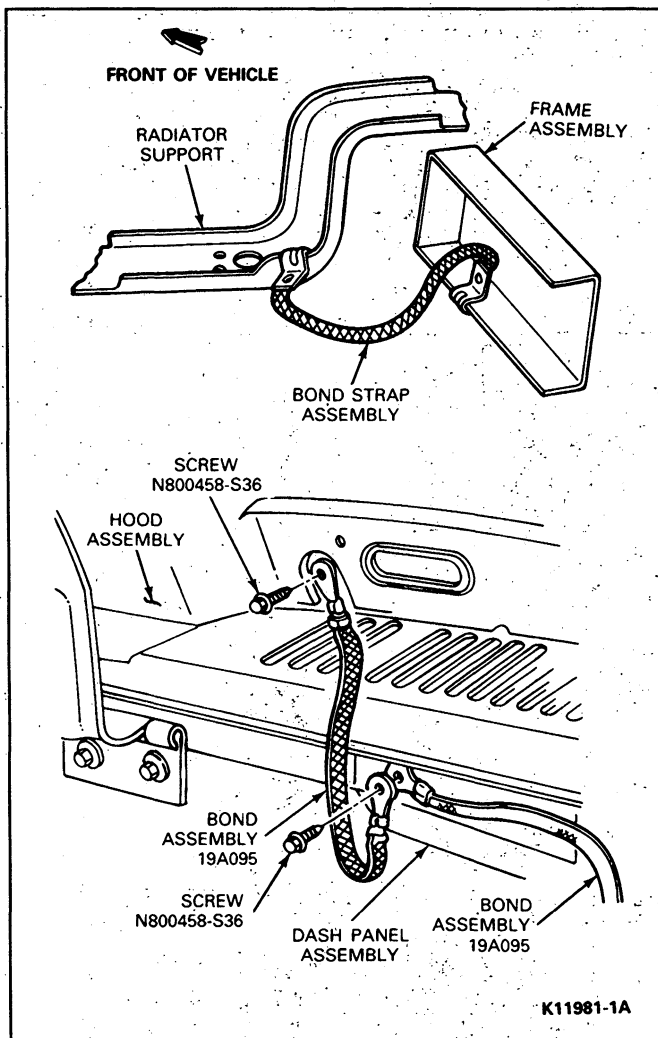


FIG. 7 Radio Suppression Equipment Gasoline Engines



**FIG. 8 Radio Bond Strap F-150-F-350, F-Super Duty and Bronco**

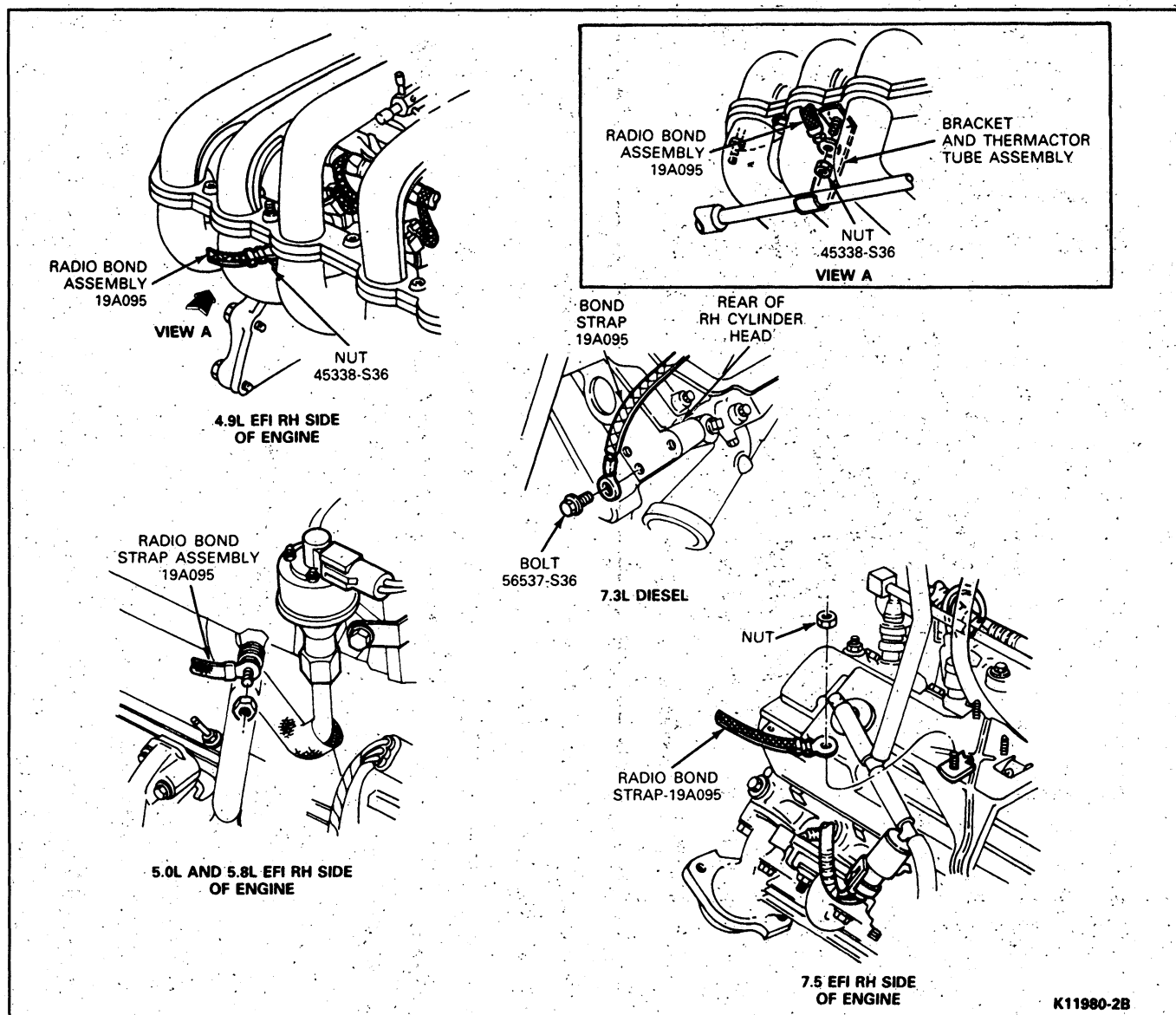


FIG. 9 Radio Suppression Equipment—Engine Mounted

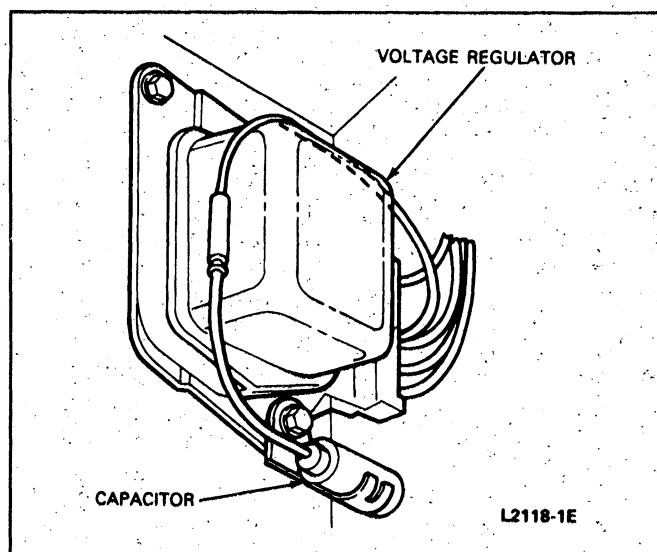


FIG. 10 Radio Suppression Equipment 7.3L Diesel and Gasoline with Heavy Duty Alternator

## SPECIAL SERVICE TOOLS

## ROTUNDA EQUIPMENT

Model	Description
007-00001	Digital Volt Ohmmeter

CK9061-1B

# SECTION 35-11 Antennas

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd)	
Manual Entertainment Radio Antenna .....	35-11-1	Antenna Base and Cable (Cont'd)	
DIAGNOSIS AND TESTING .....	35-11-1	F-150—F-350, F-Super Duty, and	
REMOVAL AND INSTALLATION		Bronco .....	35-11-1
Antenna Base and Cable .....	35-11-1	SPECIAL SERVICE TOOLS .....	35-11-8
E-150—E-350 .....	35-11-1	VEHICLE APPLICATION .....	35-11-1

## VEHICLE APPLICATION

All Models.

## DESCRIPTION AND OPERATION

### Manual Entertainment Radio Antenna

The manual entertainment radio antenna is not adjustable.

## DIAGNOSIS AND TESTING

### Poor Reception

- If AM reception is extremely poor and FM reception "spits" or appears to have trouble holding stations, ensure the antenna and antenna connectors are properly mated. If the antenna connectors are properly mated but the reception is still poor, refer to Antenna Tests 1 through 4 in this Section.
- If only FM reception is poor, it is unlikely that the antenna is at fault. Remove the radio chassis for service.

NOTE: Many customers do not understand the limitations of FM reception. Refer the customer to the Owner's Guide for information about the limitations of FM radio performance.

## REMOVAL AND INSTALLATION

### Antenna Base and Cable

#### F-150—F-350, F-Super Duty, and Bronco

#### Removal

The antenna mast in the F-150—F-350, F-Super Duty, and Bronco is detachable (Fig. 1).

1. Disconnect the antenna lead-in cable from the radio (Fig. 2).
2. Disengage the cable from the retainer at the top of the heater plenum.

NOTE: It may be necessary to remove the glove compartment to gain access to the antenna lead-in cable.

3. Unsnap the cap from the antenna base and remove the cap.
4. Remove four antenna attaching screws and remove the antenna base, gasket and lead-in cable from the vehicle.

## Installation

1. Place the gasket on the cowl panel over the antenna opening (Fig. 1).
2. Insert the antenna lead-in cable into the antenna hole in the cowl until the antenna base is seated on the cowl.
3. Install the four antenna attaching screws.
4. Place the cap in position over the antenna base and snap the cap onto the base.
5. Route the antenna lead-in cable to the retainer at the top of the heater plenum.
6. Connect the antenna lead-in cable to the radio and check the radio operation.

#### E-150—E-350

#### Removal

The antenna mast on the E-150—E-350 is detachable (Fig. 3).

1. Remove the cowl top grille panel above the radio.
2. Disconnect the antenna lead-in cable from the radio (Fig. 3).
3. Unsnap the two retaining clips from the antenna cable.
4. Unsnap the stanchion from the antenna base and remove the stanchion.
5. Remove the four antenna attaching screws and remove the base and cable assembly from the vehicle.

#### Installation

1. Insert the tip of the new antenna cable through the fender opening and thread the antenna cable to the antenna base. Plug the antenna in to the base.
2. Install the four attaching base-to-vehicle screws.
3. Install the stanchion to the antenna base.
4. Inside the vehicle, snap the antenna cable to the two retaining clips, along the cowl top (Fig. 3).
5. Insert the antenna cable through the hole in the dash panel. From inside the vehicle, pull the cable to tightly seat the rubber grommet and seal the cable entry hole.
6. Connect the antenna lead-in cable to the radio and install the cowl top grille panel.



**RADIO ANTENNA TEST (ALL ANTENNA TYPES)**

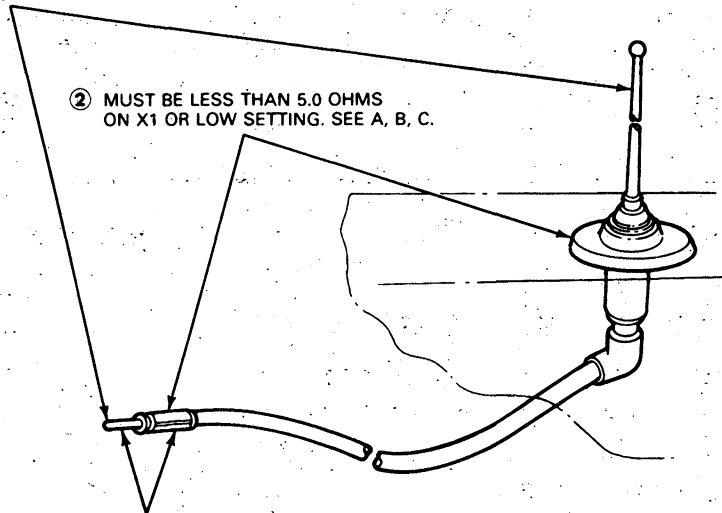
WITH ANTENNA INSTALLED ON VEHICLE AND CABLE UNPLUGGED FROM RADIO, PERFORM THE FOLLOWING RESISTANCE TESTS WITH AN OHMMETER. PROBES MUST CONTACT ANTENNA AT POINTS SPECIFIED BY ARROWHEADS.

**ANTENNA TEST NO. 1**

① MUST BE LESS THAN 5.0 OHMS  
ON X1 OR LOW SETTING.

② MUST BE LESS THAN 5.0 OHMS  
ON X1 OR LOW SETTING. SEE A, B, C.

③ MUST BE AT INFINITY ( $\infty$ ) ON X1000  
SETTING OR HIGHEST RANGE AVAILABLE.

**RESULTS**

IF OHMMETER TESTS ARE SATISFACTORY — THE ANTENNA IS GOOD.

**ACTION**

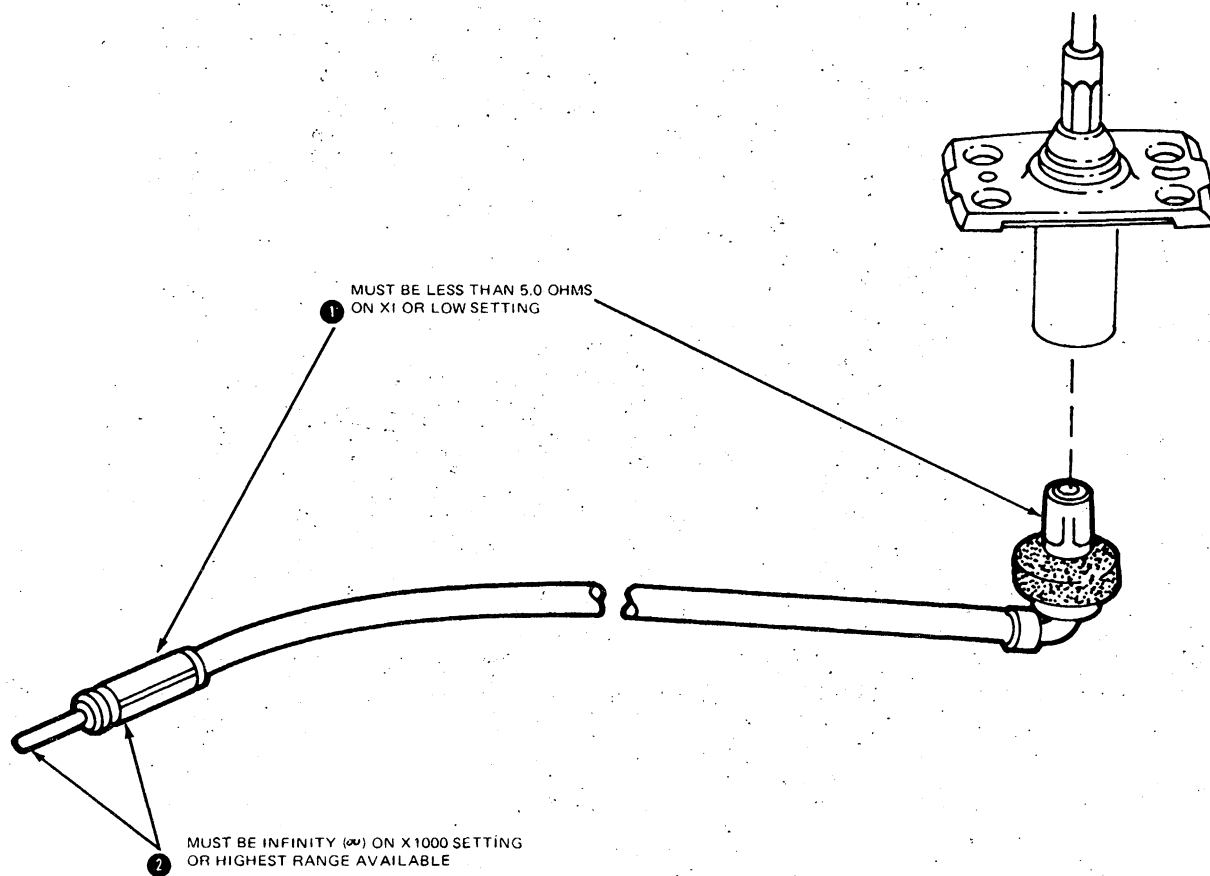
IF ANY OHMMETER READING IS UNSATISFACTORY TAKE THE FOLLOWING ACTION:

- A. IF ONE PIECE ASSEMBLY, REPLACE THE COMPLETE ANTENNA AND CABLE ASSEMBLY.
- B. IF DETACHABLE CABLE AND MAST, PERFORM ANTENNA TEST NO. 2 AND 3.
- C. IF MANUAL ANTENNA WITH EXTENSION CABLE, PERFORM ANTENNA TEST NO. 4.

CK8980-2A

**TESTING ANTENNA EQUIPPED WITH DETACHABLE CABLE AND MAST.**

WHEN RESULTS IN TEST NO. 1 HAVE BEEN UNSATISFACTORY, DISCONNECT THE ANTENNA MAST AND BASE FROM THE CABLE. PERFORM THE FOLLOWING TESTS:

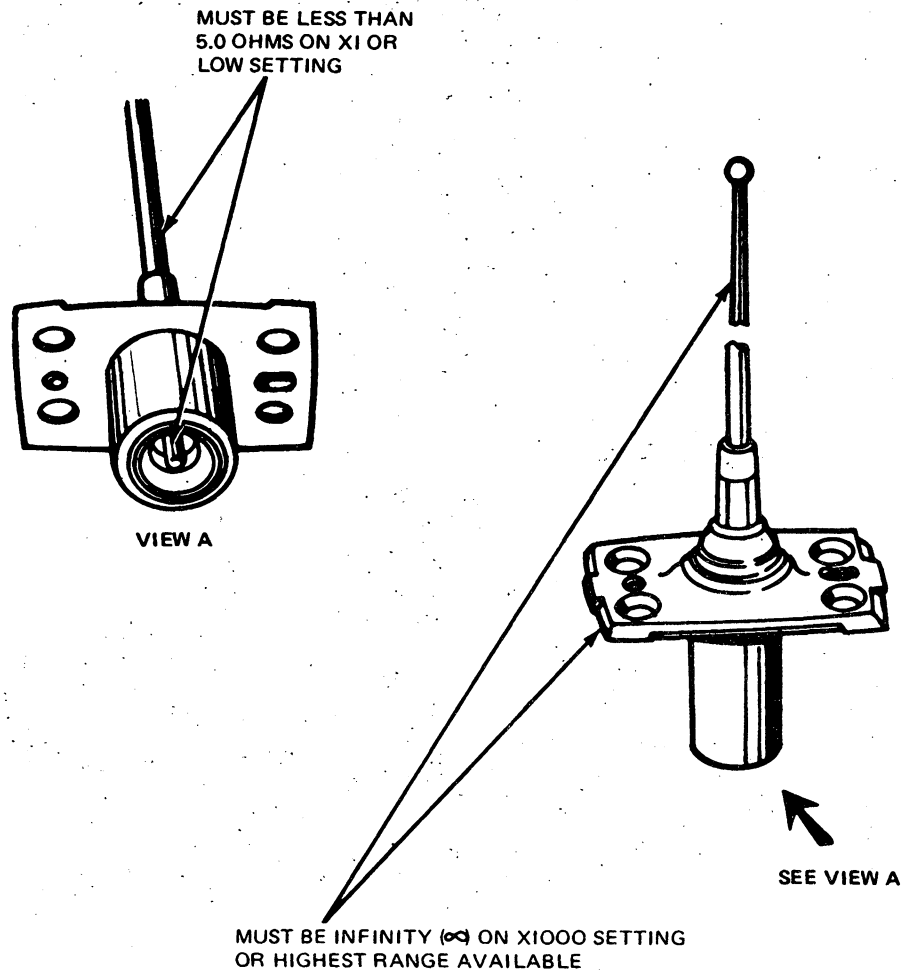
**ANTENNA TEST NO. 2****RESULTS**

IF OHMMETER READINGS ARE SATISFACTORY, THE CABLE IS GOOD. PERFORM ANTENNA TEST NO. 3

**ACTION**

IF EITHER READINGS IS UNSATISFACTORY, REPLACE THE CABLE.

CK4251-2A

**ANTENNA TEST NO.3****RESULTS**

IF OHMMETER READINGS ARE SATISFACTORY, ANTENNA MAST AND BASE ARE GOOD, REPLACE CABLE.

**ACTION**

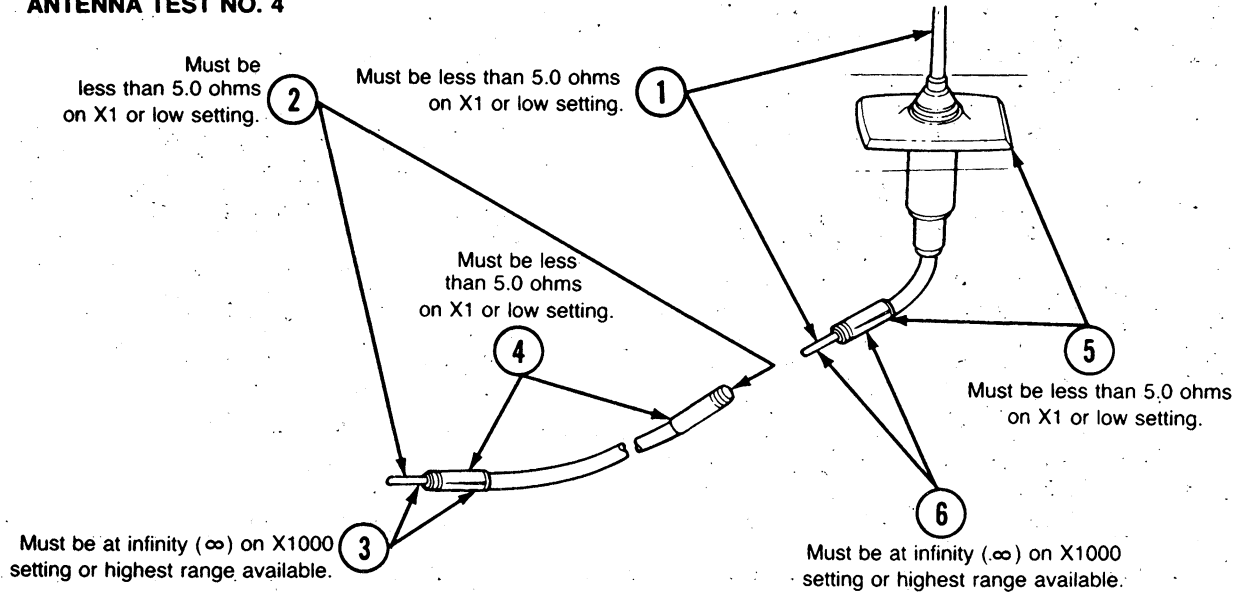
IF EITHER READING IS UNSATISFACTORY, REPLACE ONLY THE BASE ASSEMBLY, THE MAST SHOULD BE GOOD.

CK4252-A

### TESTING ANTENNA WITH EXTENSION CABLE

When results in test No. 2 have been unsatisfactory, disconnect extension cable from main cable. Perform the following tests:

#### ANTENNA TEST NO. 4



#### RESULTS

If ohmmeter readings are satisfactory, the extension cable and main antenna cable are good. Perform test No. 3.

#### ACTION

If either reading on extension cable is unsatisfactory, replace extension cable.

If either reading on main antenna cable is unsatisfactory take the following action:

- A. If one piece assembly, replace the complete antenna and main cable assembly.
- B. If main cable is detachable, perform antenna test No. 2 and 3.

CK5159-2A

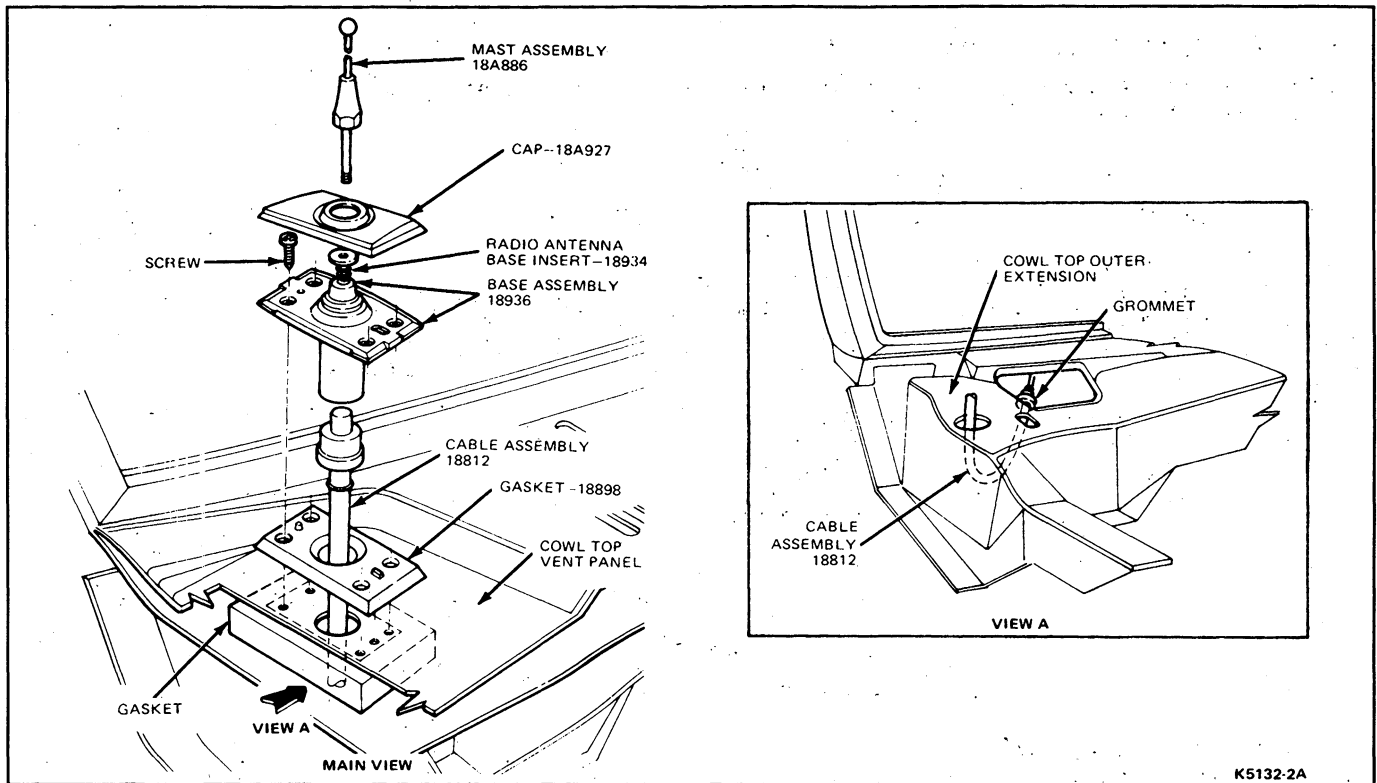


FIG. 1 Entertainment Antenna Installation—F-150 Through F-350, F-Super Duty, and Bronco

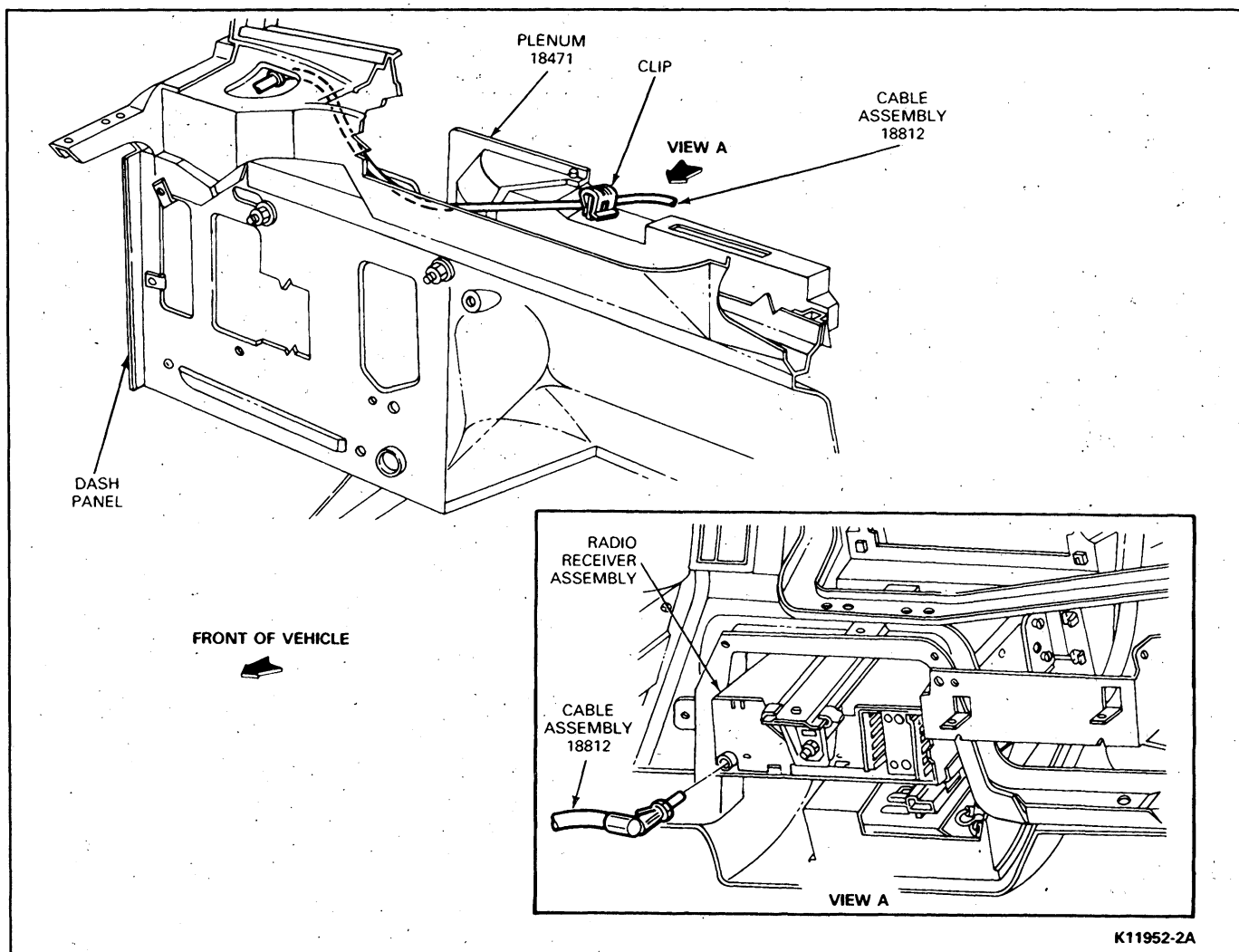


FIG. 2 Entertainment Radio Antenna Cable—F-150 Through F-350, F-Super Duty, and Bronco

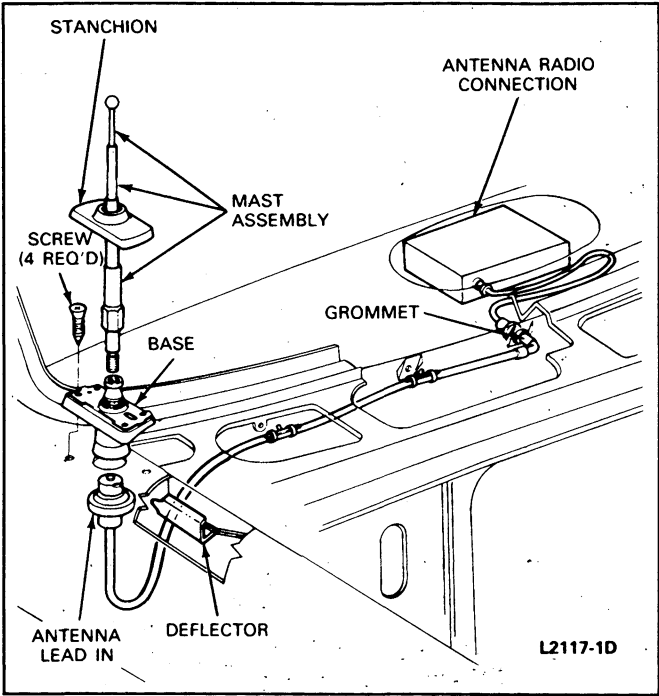


FIG. 3 Antenna Installation—E-150—E-350

SPECIAL SERVICE TOOLS

ROTUNDA EQUIPMENT	
Model	Description
007-00001	Digital Volt Ohmmeter

CK9061-1B

# SECTION 35-31 Speakers

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION .....	35-31-1	REMOVAL AND INSTALLATION (Cont'd)	
DIAGNOSIS AND TESTING .....	35-31-2	Rear Speakers .....	35-31-1
REMOVAL AND INSTALLATION		VEHICLE APPLICATION .....	35-31-1
Door Speakers .....	35-31-1		
Instrument Panel Speaker .....	35-31-1		

## VEHICLE APPLICATION

All Models.

## DESCRIPTION

Econoline vehicles are equipped with a single standard instrument panel speaker with AM radio and two door speakers with stereo radio. F-Series & Bronco are equipped with two door speakers with AM radio. Bronco & Econoline have two additional rear speakers with stereo radios. All except the instrument panel speaker are premium speakers.

## REMOVAL AND INSTALLATION

### Instrument Panel Speaker

#### E-150—E-350

##### Removal

1. Remove four screws attaching the grille and speaker assembly to the instrument panel (Fig. 1).
2. Disconnect the speaker wires at the radio speaker connector.
3. Remove four nuts and washers and separate the grille from the speaker (entertainment radio only).

##### Installation

1. Position grille to speaker and install the four washers and nuts.
2. Connect the speaker wires to the radio speaker connector.
3. Position the speaker and grille assembly to the instrument panel. Install four screws and secure.

### Rear Speakers

#### Bronco and E-150—E-350

##### Removal

1. Remove four screws attaching speaker and grille to the rear trim panel (Figs. 3 and 4).
2. Remove speaker and grille and disconnect the wires at the connector located behind the speaker (Figs. 3 and 4).

**CAUTION:** Do not operate the radio with the speaker disconnected.

##### Installation

1. To install, connect wires to connector and position speaker and grille to door trim panel.
2. Install the four attaching screws, and check operation of the speaker (Figs. 3 and 4).

### Door Speakers

#### E-150—E-350

##### Removal

1. Remove four screws attaching speaker and grille to door trim panel.
2. Remove speaker and grille and disconnect the wires at the connector located behind the speaker. Do not operate the radio with the speaker disconnected (Fig. 3).

##### Installation

1. To install, connect wires to connector and position speaker and grille to door trim panel.
2. Install the four attaching screws, and check operation of the speakers (Fig. 3).

#### F-150—F-350, F-Super Duty and Bronco

##### Removal

1. Remove door trim panel. Refer to Section 45-03, Door Trim Panel.
2. Remove four screws attaching speaker and disconnect wiring (Fig. 2).

**NOTE:** Do not operate radio with speakers disconnected.





##### Installation

1. Connect wiring and install speaker. Secure with four screws (Fig. 2).
2. Install door trim panel. Refer to Section 45-03, Door Trim Panel.

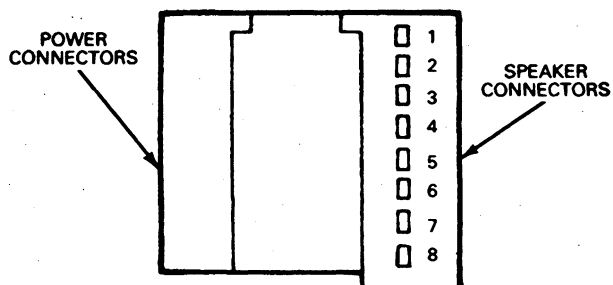


## DIAGNOSIS AND TESTING

**SPEAKER DIAGNOSTICS**  
**ONE OR MORE SPEAKER DISTORTED, OR INOPERATIVE**

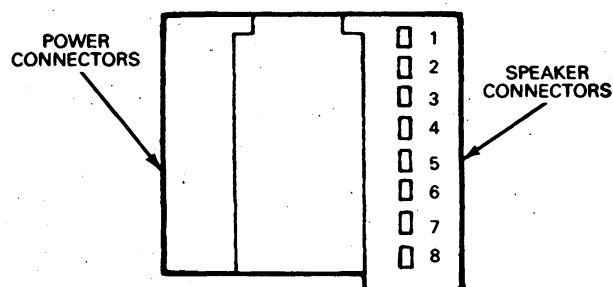
TEST STEP		RESULT	ACTION TO TAKE
<b>2.0</b>	<b>DURING CHECK, ONE OR MORE SPEAKERS INOPERATIVE OR DISTORTED</b>		
<b>2.1</b>	<b>SUBSTITUTE SPEAKER</b>		
<ul style="list-style-type: none"> <li>If vehicle is equipped with premium sound proceed to Section 35-01, Radio and Premium Sound for speaker diagnostics.</li> <li>Unplug radio from speaker wiring harness. Set radio balance and fader controls at their center. Using a speaker of known good quality and the following chart, jumper the pins corresponding to the suspect speaker of the radio connector to the test speaker.</li> </ul>		Sound from speaker 	GO to 2.2.
		Sound from speaker 	REMOVE radio for service.
<b>2.2</b>	<b>USE JUMPER WIRE ACROSS RADIO CONNECTOR</b>		
<ul style="list-style-type: none"> <li>Unplug the suspect speaker from the wire harness and jumper the appropriate radio connector ring to the speaker (following charts).</li> </ul>		Sound from speaker 	CHECK and REPAIR speaker wiring harness for a short or a break in the harness.
		Sound from speaker 	REMOVE and REPLACE speaker.

CK5342-2C

**AM ELECTRONIC RADIO INTEGRAL CONNECTOR — SPEAKERS**

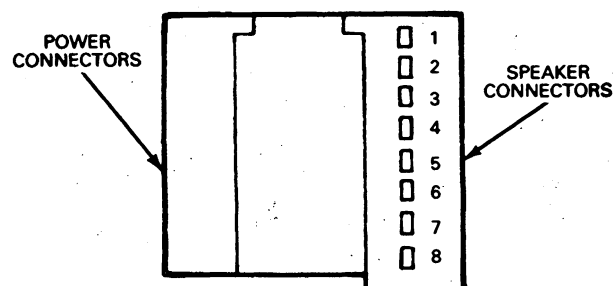
Pin	Function
1	Front
2	Common
3	
4	
5	Front
6	Common
7	
8	

Models: All

**AM/FM & AM/FM/CASS — W/O FADER  
ELECTRONIC RADIO INTEGRAL CONNECTOR — SPEAKERS**

Pin	Function
1	Left
2	Common
3	
4	
5	Right
6	Common
7	
8	

Models: F-150/350, F-Super Duty

**AM/FM & AM/FM/CASS — W/FADER  
ELECTRONIC RADIO INTEGRAL CONNECTOR — SPEAKERS**

Pin	Function
1	Left Front
2	Common
3	Left Rear
4	Common
5	Right Front
6	Common
7	Right Rear
8	Common

Models: Bronco  
E-150/350

CK10451-2B

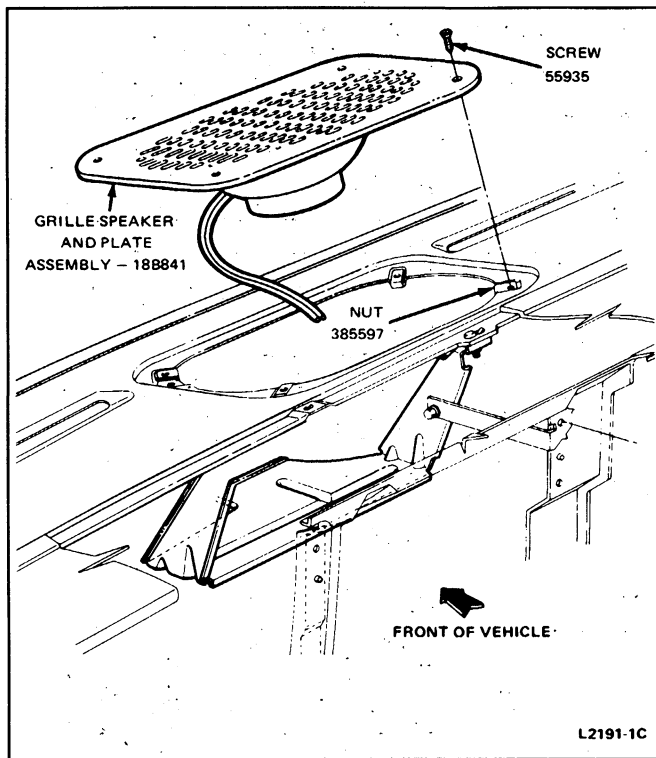


FIG. 1 AM Radio Speaker Installation—E-150—E-350

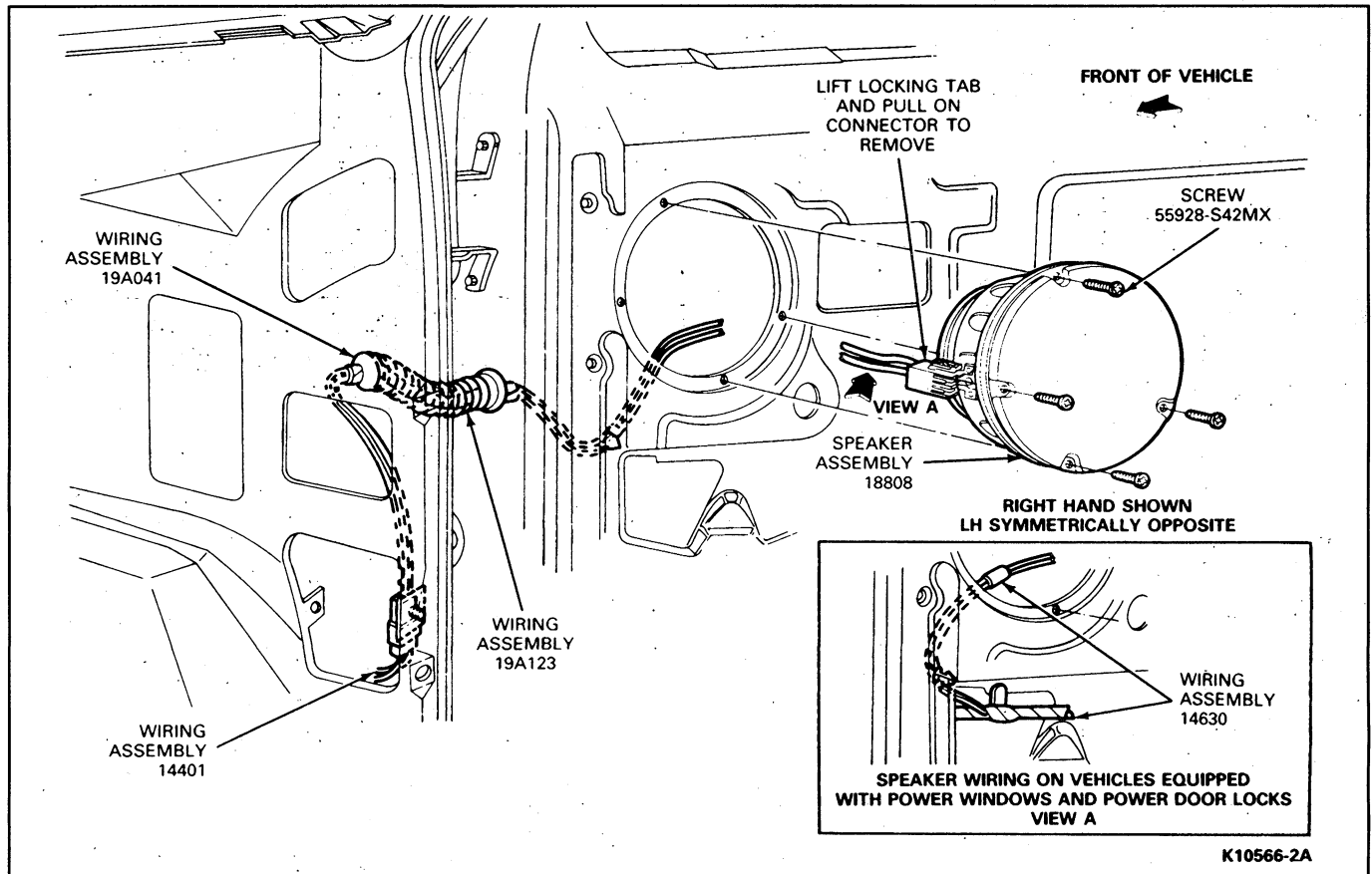


FIG. 2 Door Speakers—F-150—F-350, F-Super Duty, and Bronco

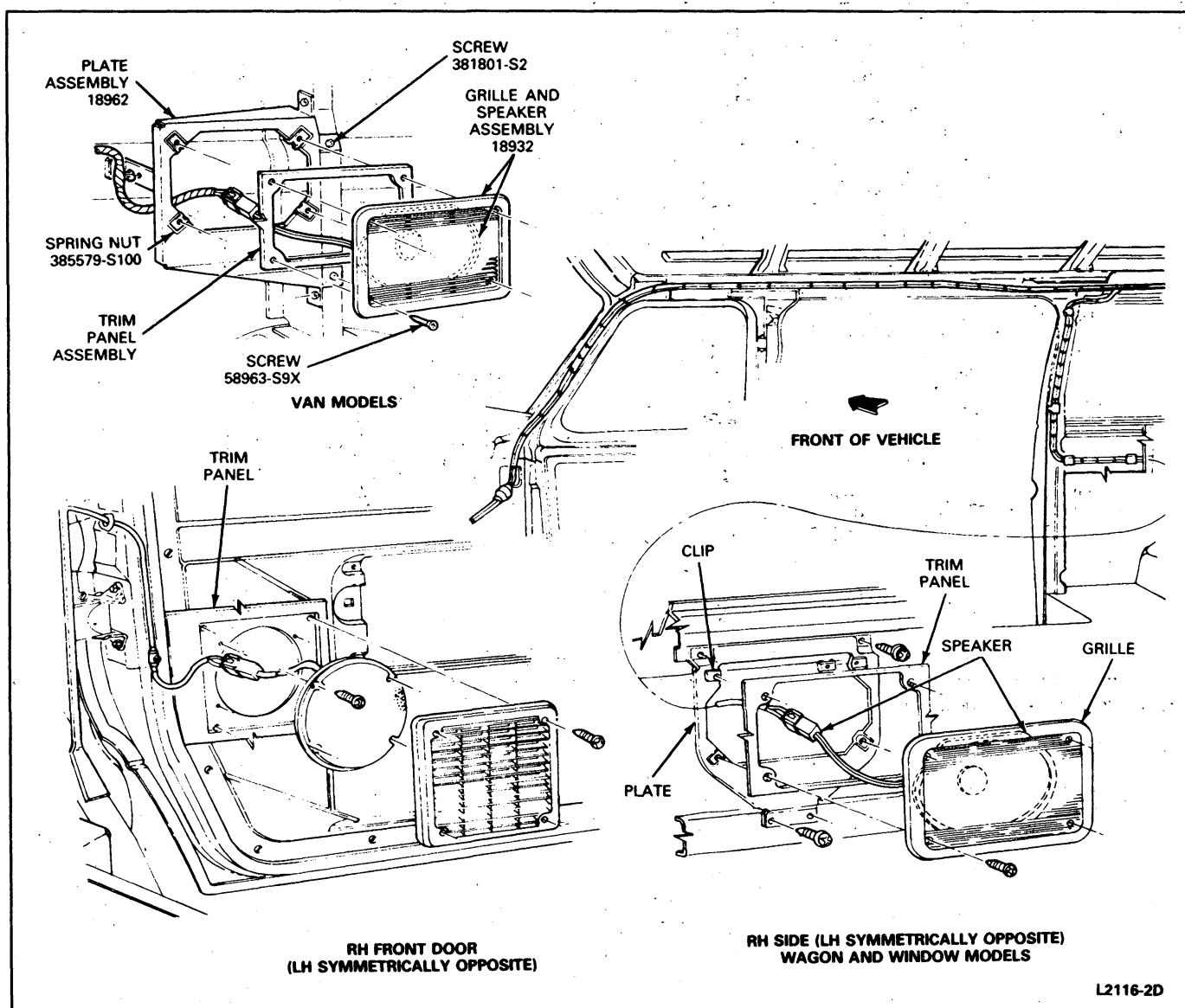
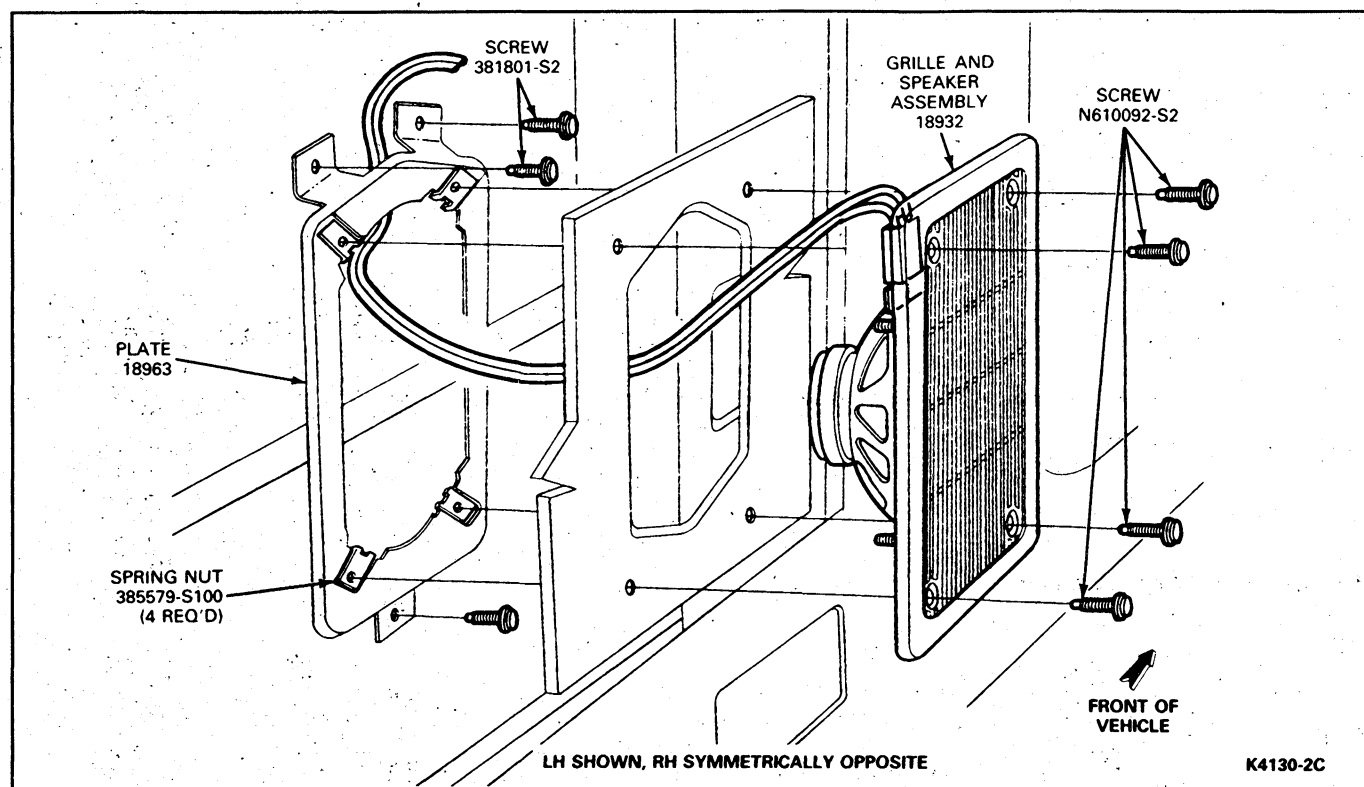


FIG. 3 Front and Rear Door Speakers—E-150—E-350

**FIG. 4 Rear Speakers—Bronco**

# SECTION 35-40 Ash Receptacles and Cigar Lighter

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS AND TESTING		REMOVAL AND INSTALLATION (Cont'd)	
Diagnosis Guide .....	35-40-1	Cigar Lighters .....	35-40-1
REMOVAL AND INSTALLATION		VEHICLE APPLICATION .....	35-40-1
Ash Receptacles .....	35-40-1		

## VEHICLE APPLICATION

All E-150-E-350, F-150-F-350, F-Super Duty and Bronco.

## DIAGNOSIS AND TESTING

Possible problems associated with the cigar lighter are listed in the following Diagnosis Guide along with possible causes and correction steps.

## REMOVAL AND INSTALLATION

### Ash Receptacles

#### Removal

To remove ash receptacle shield assembly, first remove ash receptacle.

1. Remove center finish panel.
2. Remove the two screws that attach the ash receptacle retainer to the instrument panel.
3. Pull the retainer rearward to remove the assembly from the front of the instrument panel.
4. Tip the rear of the retainer down to clear the electrical connector and leg at shield. Remove the assembly from the instrument panel.
5. Disconnect electrical connector.

#### Installation

1. Connect electrical connector.

### Diagnosis Guide

CONDITION	POSSIBLE CAUSE	RESOLUTION
Cigar lighter — knob pops out before adequate heating.	1. Cigar lighter element. 2. Cigar lighter socket.	1. Substitute another element. Replace if necessary. 3. Replace socket.
Cigar lighter — element stays in, will not heat up.	1. Fuse burnt out. 2. Open circuit in wiring. 3. Cigar lighter element. 4. Cigar lighter socket.	1. Replace fuse. If fuse blows again, check for short circuit. 2. Check for power to socket. Repair if necessary. 3. Substitute another element. Replace if necessary. 4. Replace socket.

2. Position the shield assembly to the opening in the rear side of the instrument panel, lifting the assembly onto the alignment pins.
3. Push shield assembly forward to engage pins on instrument panel.
4. Install the two screws attaching the shield assembly to the instrument panel.
5. Install center finish panel.

NOTE: For the F-150—F-350, F-Super Duty and Bronco only, remove the ash receptacle retainer assembly to facilitate cigar lighter removal.

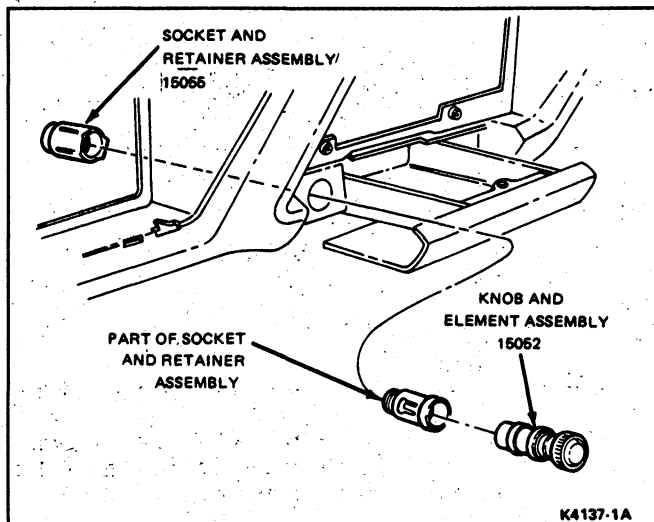
### Cigar Lighters

#### Removal

1. Disconnect the battery ground cable.
2. Open ash receptacle door.
3. Remove the lighter element (Figs. 1 and 2).
4. Depress tongue on detent spring and remove door assembly.
5. Disconnect the push-on connector from the base of the lighter socket (remove the ground when provided).
6. Unscrew the socket and retainer.
7. Remove the socket from the rear of the door assembly and the retainer from the front.

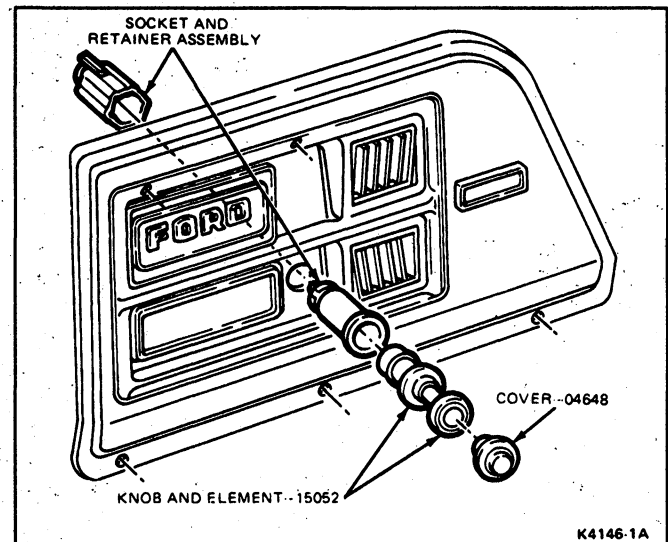
#### Installation

1. Replace the retainer in the door assembly from the front.



**FIG. 1 Cigar Lighter Installation—F-150—F-350, F-Super Duty and Bronco**

2. Install the socket into the retainer using care not to damage the bimetal contacts.
3. Reconnect the push-on connector to the base of the lighter socket (reconnect the ground when provided).



**FIG. 2 Cigar Lighter Installation—E-150—E-350**

4. Replace door assembly into receptacle shield pivots. Position and rotate upward to close.
5. Replace the lighter element and reconnect the battery ground cable.
6. Test for proper operation.

# SECTION 35-50 Mirrors—Inside and Outside

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION .....	35-50-1	REMOVAL AND INSTALLATION (Cont'd)	
REMOVAL AND INSTALLATION		Outside Rearview Mirror (Cont'd)	
Inside Rearview Mirror .....	35-50-1	Conventional Type .....	35-50-1
Mounting Bracket .....	35-50-1	Western Type .....	35-50-1
Outside Rearview Mirror .....	35-50-1	VEHICLE APPLICATION .....	35-50-1

## VEHICLE APPLICATION

All Models.

## DESCRIPTION

Dual western mirrors are available on all vehicles.

## REMOVAL AND INSTALLATION

### Inside Rearview Mirror

#### Removal

1. Loosen the mirror assembly-to-mounting bracket set screw (Fig. 1).
2. Remove the mirror assembly by sliding upward and away from the mounting bracket.

#### Installation

1. Attach the mirror to the mounting bracket. Tighten the set screw to 1.13-2.26 N·m (10-20 in-lb).

### Mounting Bracket

#### Removal

To remove the mirror mounting bracket and vinyl pad from the windshield, apply low heat from an electric heat gun until the vinyl softens. Then peel the pad off the windshield and discard.

#### Installation

1. Make sure glass, bracket and Rear View Mirror Repair Kit D9AZ-19554-B (ESB-M2G176-A) or equivalent are at least at room temperature (18.3-23.9°C or 65-75°F).
2. Locate and mark the mirror mounting bracket location on the outside surface of the windshield.

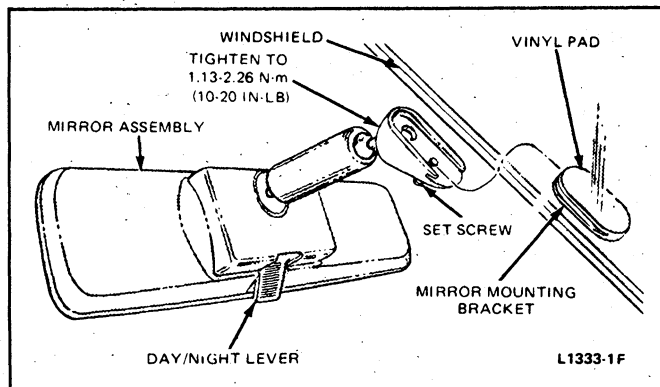


FIG. 1 Inside Rearview Mirror Installation

3. Thoroughly clean bonding surfaces of glass and bracket to remove old adhesive. Use mild abrasive cleanser on glass and fine sand paper on bracket to lightly roughen surface. Wipe clean with alcohol-moistened cloth.
4. Crush accelerator vial (from Rear View Mirror Repair Kit D9AZ-19554-B or equivalent) and apply accelerator to bonding surface of bracket and windshield. Let dry three minutes.
5. Apply two drops of adhesive from kit D9AZ-19554-B or equivalent to the mounting surface of the bracket. Using a clean toothpick or wooden match, quickly spread the adhesive evenly over the mounting surface of the bracket.
6. Quickly position the mounting bracket on the windshield. The 9.5mm (3/8 inch) circular depression in the bracket must be toward the bottom edge and toward the inside of the cab. Press the bracket against the windshield for approximately one minute.
7. Allow the bond to set for five minutes. Then, remove any excess bonding material from the windshield with an alcohol-dampened cloth.

### Outside Rearview Mirror

#### Conventional Type

The conventional outside rearview mirror is mounted on the door. To remove the mirror, remove the attaching screws and lift off the mirror and gasket (Fig. 2).

#### Western Type

The dual position outside rearview mirrors are mounted on both doors. The mirrors may be removed from the doors by removing the attaching screws (Fig. 3). Broken mirror glass may be replaced on the mounting bracket using Silicone Rubber D6AZ-19562-A (ESB-M4G92-A and ESE-M4G195-A) or equivalent and following the procedures listed below.

**CAUTION:** The mirror glass must be installed with the reflective coated side exposed to ensure adequate performance. Touching the glass with the point of a pencil will show a point-to-point image on the reflective surface only.

1. Break out and discard the larger fragments of the broken mirror glass.
2. Remove the smaller fragments from around the perimeter with a flat-bladed knife.



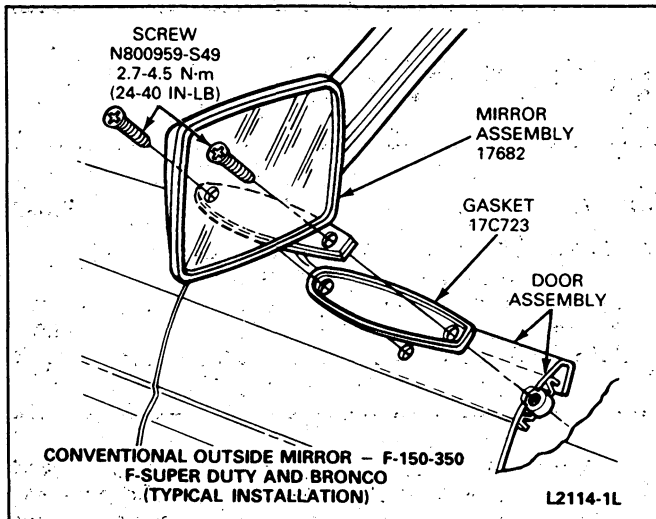


FIG. 2 Conventional Outside Mirrors

3. If dust or dirt has accumulated inside the mirror base, wash it and allow it to dry thoroughly before proceeding.
4. Using Ford Silicone Rubber D6AZ-19562-A (ESB-M4G92-A and ESE-M4G195-A) or equivalent, apply a 3.2mm (1/8 inch) by 25.4mm (1.00 inch) diameter bead on each of the four upper mounting pads. Apply a continuous 3.2mm (1/8 inch) diameter bead 101.6mm (4.00 inches) long across the two lower center mounting pads on the mirror head.
5. Press the glass firmly into the case **PRIMARY SIDE OUT**, and secure with a rubber band pressing a small pad of styrofoam against the center of the glass. The rubber band should remain in place for a minimum of 24 hours to retain the glass until the silastic is cured.

### Recreation Swing-Out Mirror

The Recreation mirror may be removed from the doors by removing the four retaining screws on E-150—E-350, and five screws on F-150—F-350, F-Super Duty and Bronco (Fig. 4).

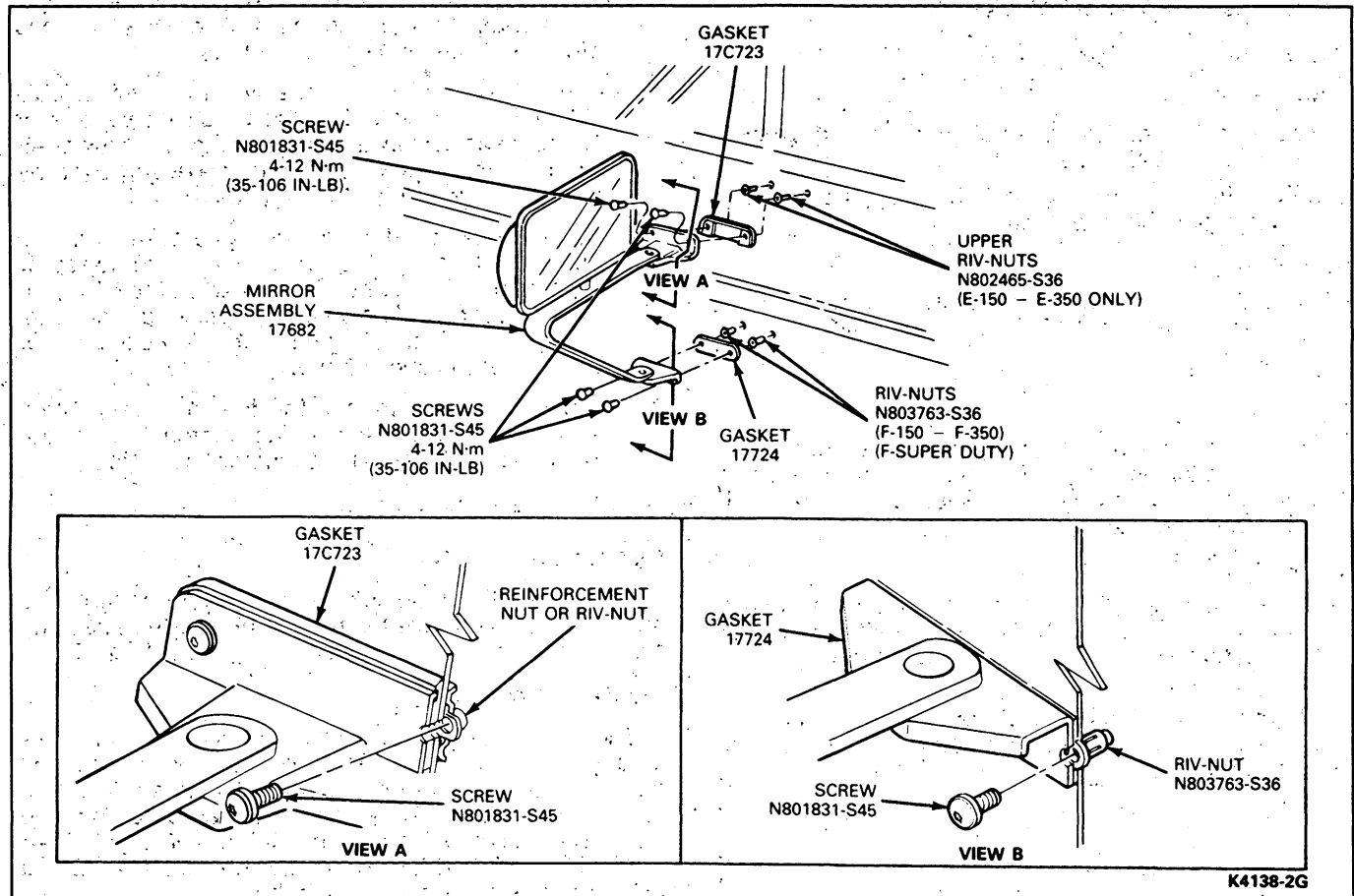


FIG. 3 Western Type Mirror Installations

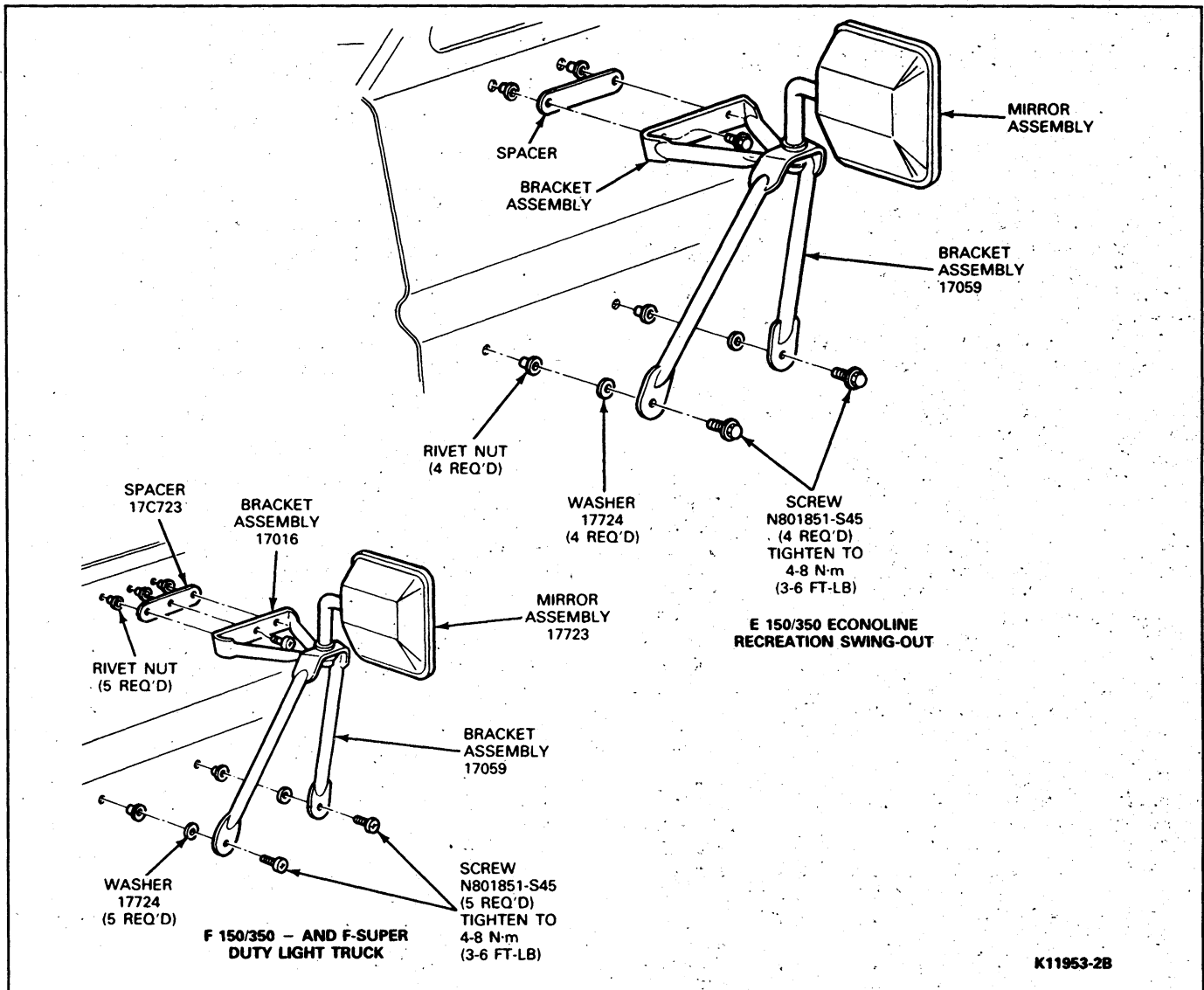


FIG. 4 Recreation Swing-Out Mirror

# SECTION 35-60 Windshield Wipers—Electric

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>DIAGNOSIS AND TESTING (Cont'd)</b>	
Arm and Blade Assembly .....	35-60-11	Standard Windshield Wiper System "B" Test E-150—E-350 (Cont'd)	
<b>CLEANING AND INSPECTION</b> .....	35-60-16	Low-Speed Test .....	35-60-4
<b>DESCRIPTION AND OPERATION</b>		Park-Operation Test .....	35-60-4
Governor .....	35-60-4	Windshield Wiper Interval Governor Test .....	35-60-11
Interval Wipers .....	35-60-4	Wiper Motor Current Draw .....	35-60-9
Bronco, F-150 Through F-350 and F-Super Duty .....	35-60-4	Wiper Switch Continuity Test .....	35-60-10
E-150—E-350 .....	35-60-4	<b>DISASSEMBLY AND ASSEMBLY</b>	
Standard Wipers .....	35-60-1	Brush End Plate .....	35-60-16
<b>DIAGNOSIS AND TESTING</b>		E-150—E-350 .....	35-60-16
Circuit Breaker Test—F-150—F-350, F-Super Duty and Bronco Only .....	35-60-10	Cover and Switch Assembly .....	35-60-16
Test 1 .....	35-60-10	<b>MAINTENANCE</b>	
Test 2 .....	35-60-10	Windshield Wiper Blade Replacement .....	35-60-17
Diagnosis Guides .....	35-60-11	Windshield Wiper Blades .....	35-60-17
Interval Windshield Wiper System "B"		<b>REMOVAL AND INSTALLATION</b>	
Motor Test—E-150—E-350 .....	35-60-8	Arm and Blade Assembly-To-Pivot	
High-Speed Test .....	35-60-8	Shaft .....	35-60-15
Interval Operation Test .....	35-60-8	Interval Governor .....	35-60-15
Low-Speed Test .....	35-60-8	F-150 Through F-350, F-Super Duty, Bronco and E-150—E-350 .....	35-60-15
Park Operation Test .....	35-60-8	Pivot Shaft and Linkage .....	35-60-15
Interval Windshield Wiper System "E"		E-150—E-350 .....	35-60-15
Motor Test F-150—F-350, F-Super Duty and Bronco .....	35-60-7	F-150—F-350, F-Super Duty and Bronco .....	35-60-16
High-Speed Test .....	35-60-7	Rubber Element To Wiper Blade .....	35-60-15
Interval Operation Test .....	35-60-7	Wiper Control Switch .....	35-60-15
Low-Speed Test .....	35-60-7	E-150—E-350 .....	35-60-15
Park Operation Test .....	35-60-8	F-150—F-350, F-Super Duty and Bronco .....	35-60-15
Quick Check .....	35-60-7	Wiper Motor .....	35-60-12
Standard Windshield Wiper System "B"		E-150—E-350 .....	35-60-13
Test E-150—E-350 .....	35-60-7	F-150—F-350, F-Super Duty and Bronco .....	35-60-12
High-Speed Test .....	35-60-7	<b>SPECIAL SERVICE TOOLS</b> .....	35-60-20
Low-Speed Test .....	35-60-7	<b>SPECIFICATIONS</b> .....	35-60-20
Park-Operation Test .....	35-60-7	<b>VEHICLE APPLICATION</b> .....	35-60-1
Standard Windshield Wiper System "E"			
Test Bronco, F-150—F-350 and F-Super Duty .....	35-60-4		
High-Speed Test .....	35-60-4		

## VEHICLE APPLICATION

All Light Truck Models.

## DESCRIPTION AND OPERATION

### Standard Wipers

#### Bronco, F-150 Through F-350 and F-Super Duty (Fig. 1)

The two-speed, permanent magnet, three-brush "E" electric windshield wiper motor has a brush rigging that permits selection of low or high speed. When the control selector is in LOW position, the grounded brush and the white wire brush are used to operate the motor at low speed. When the control selector is in HI position, the grounded brush and the blue/orange wire brush are used. Current bypasses a portion of the armature winding, causing the motor to run faster. When the control selector is moved to the PARK position, the

motor will continue at low speed until the PARK switch run contacts open, stopping the motor in the PARK position.

#### E-150—E-350 (Fig. 2)

The two-speed, permanent magnet, three-brush "B" electric windshield wiper motor has a brush rigging that permits selection of low or high speed. When the control selector is in LOW position, the common (yellow wire) brush and the blue wire brush are used, operating the motor at low speed. When the control selector is in HI position, the common brush and the white/orange wire brush are used. Current bypasses a portion of the armature winding, causing the motor to run faster. When the control selector is moved to the PARK position, the motor will continue at low speed until the park switch run contacts open, stopping the motor in the PARK position.

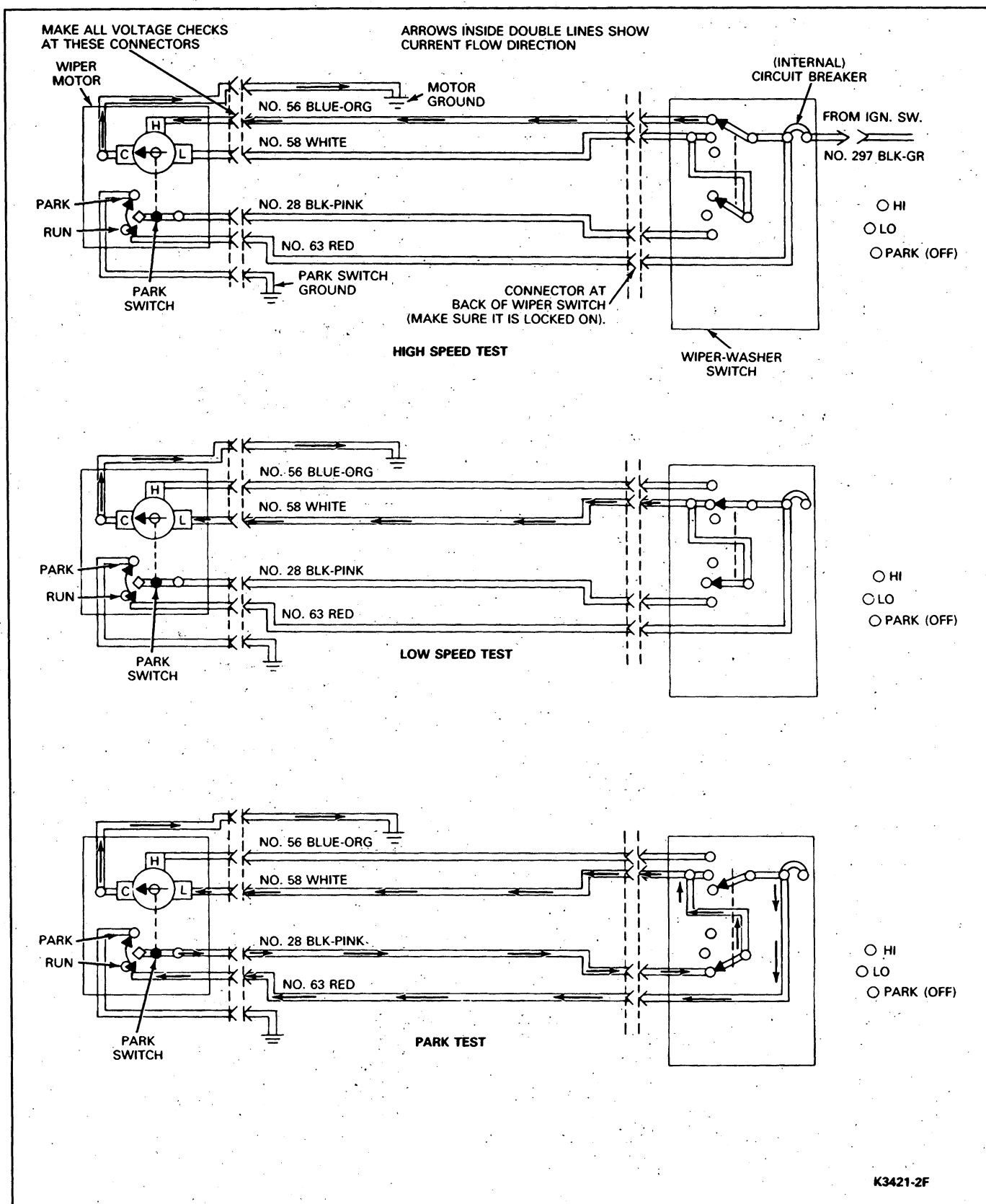


FIG. 1 Standard Windshield Wiper System "E" Motor Tests—Bronco, F-150—F-350 and F-Super Duty

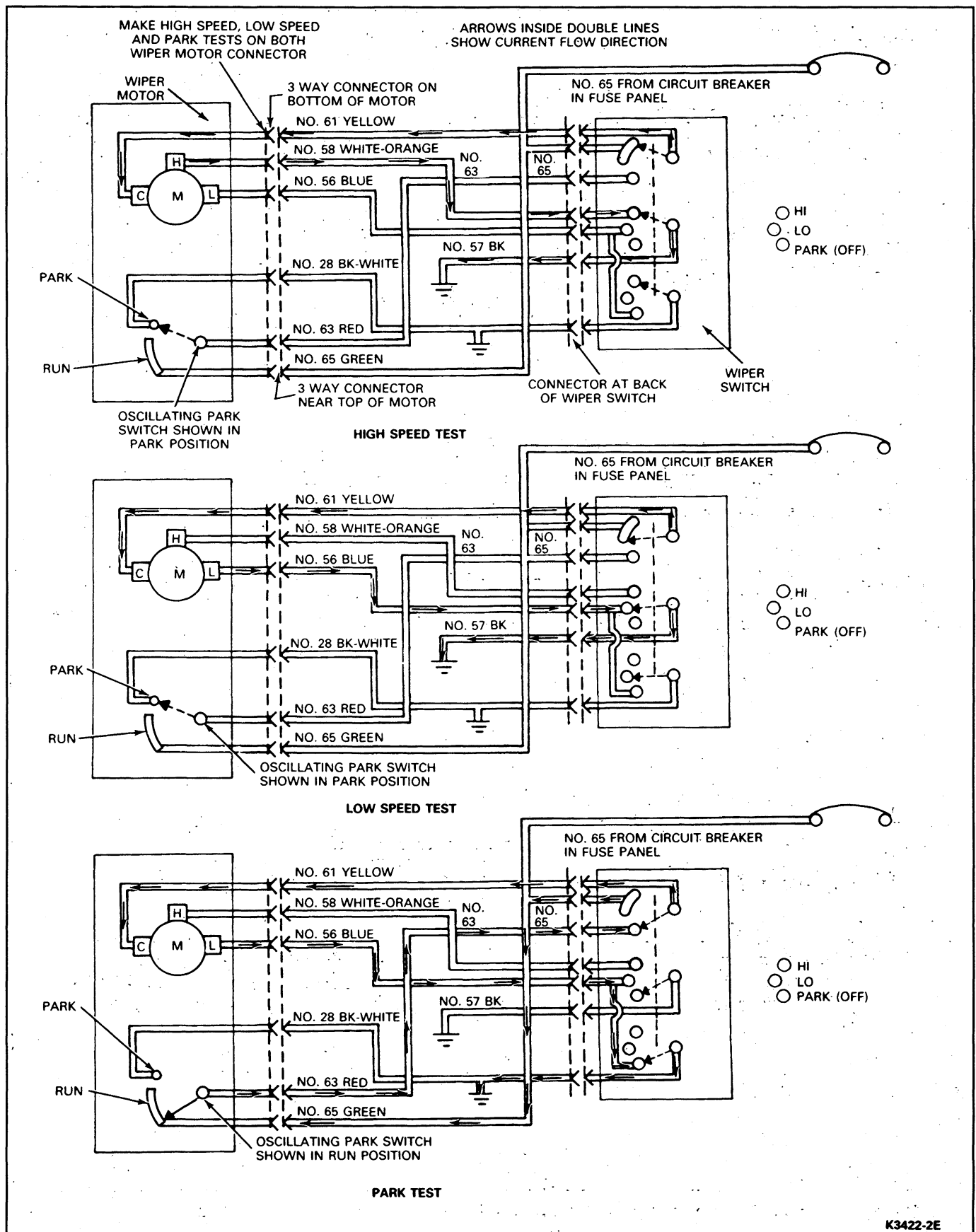


FIG. 2 Standard Windshield Wiper System "B" Motor Tests—E-150—E-350

## Interval Wipers

Optional interval wipers are available on E-150—E-350, Bronco, and F-150 through F-350 and F-Super Duty (Figs. 3 and 4).

### Bronco, F-150 Through F-350 and F-Super Duty

This is a two-speed wiper system with an interval feature (Fig. 3). For normal wiper operation, turn the wiper control knob clockwise to either of two detents (low and high speed).

For interval operation of the wiper switch, rotate the wiper control knob counterclockwise. As the knob is rotated counterclockwise, time interval between wiper blade sweeps increases.

Pushing the switch knob actuates the washer pump only. The control switch must be rotated to LOW or HI for wiping action.

### E-150—E-350

The interval operation of the windshield wiper motor is controlled by a variable resistor in the windshield wiper control switch which, in conjunction with the electronic governor, allows a variable pause between wiping cycles (Fig. 4).

For normal operation of the control switch, slide the wiper-washer knob toward the right. The first position (approximately 19mm (3/4 inch) long) is for interval, the second is for low speed and the third is for high speed.

When the control knob is placed at the LH side of the INTERVAL position, the time interval between wiper blade sweeps is at maximum. As the control is moved toward the RH side of the INTERVAL position (before the detent is felt) the time interval between sweeps is reduced.

NOTE: When the wiper control switch is set on INTERVAL, the first wipe may not occur for up to 12 seconds.

When the detent position is felt as the switch is moved toward the right, the wiper system operates at low speed. The next detent position, on the extreme right, operates the wiper system at high speed.

A variable resistor in the wiper/washer switch controls the amount of current to the electronic pause control. This, in turn, regulates wiper motor operation for the desired time interval.

The governor has a unique feature: Operation of the windshield washers while the switch is in the INTERVAL position electrically overrides the governor. This causes the wipers to operate at low speed when the washer knob is depressed.

Normal interval wiper operation resumes when the wash knob is released.

## Governor

### E-150—E-350, F-150—F-350, F-Super Duty and Bronco

The interval wiper system governor is mounted on the lower flange of the instrument panel below the wiper-washer switch.

## DIAGNOSIS AND TESTING

### Standard Windshield Wiper System "E" Test Bronco, F-150—F-350 and F-Super Duty

#### High-Speed Test

With the wiper switch in HI position, current flows from the ignition switch through the wiper switch to the wiper motor high terminal (Fig. 1). To check high-speed operation, turn ignition switch on and place wiper switch in HI position. Check for voltage at the circuit 56 pin (blue/orange wire) at three pin connector. If no voltage is present, check voltage at circuit 297 pin (black/green wire) at the wiper switch. If voltage is present at circuit 297 but not present at circuit 56, replace the wiper switch. If voltage is not present at circuit 297, trace circuit back to determine source of problem. If voltage is present at circuit 56 and motor does not run, ground the motor ground circuit to the body. If motor runs, repair ground. If motor does not run, replace motor.

#### Low-Speed Test

With the wiper switch in LOW position, current flows from the ignition switch through the wiper switch to the wiper motor low terminal (Fig. 1). To check low-speed operation, turn ignition switch on and place wiper switch in LOW position. Check for voltage at the circuit 58 pin (white wire) at three pin connector. If no voltage is present, check voltage at circuit 297 pin (black/green wire). If voltage is present at circuit 297 but not present at circuit 58, replace the wiper switch. If voltage is not present at circuit 297, trace circuit back to determine source of problem. If voltage is present at circuit 58, and motor does not run, ground motor ground circuit to the body. If motor runs, repair ground. If motor does not run, replace motor.

#### Park-Operation Test

With the wiper switch off, the wipers will complete one cycle through the wiper motor park switch. Current flows from the ignition switch through the wiper switch to the wiper motor park switch (run) for 9/10th of one cycle (Fig. 1). The low-speed run circuit current flow is from the wiper motor park switch through the wiper switch, to the motor low-speed brush, across the armature, and out a common brush to ground. At the last 1/10th portion of the cycle, the park switch moves from the RUN position to the PARK (ground) position, stopping the motor in the PARK position.

To check the park operation, turn ignition switch on and place wiper switch in the OFF position. Check for voltage at circuits 58 (white wire), 28 (black/pink dot) and 63 (red) pins at the motor connectors (Fig. 6). If voltage is present on all three circuits and wiper blades are in non-park position, ground motor ground circuit to the body. If motor parks, repair motor ground. If motor does not move to PARK position, replace motor. If voltage check shows only voltage at circuit 63 pin, replace wiper motor. If voltage check shows voltage only at circuit 63 and 28 replace wiper switch. If voltage is still not present at circuit 58, trace circuits 28 and 58 back toward wiper switch to determine source of problem.

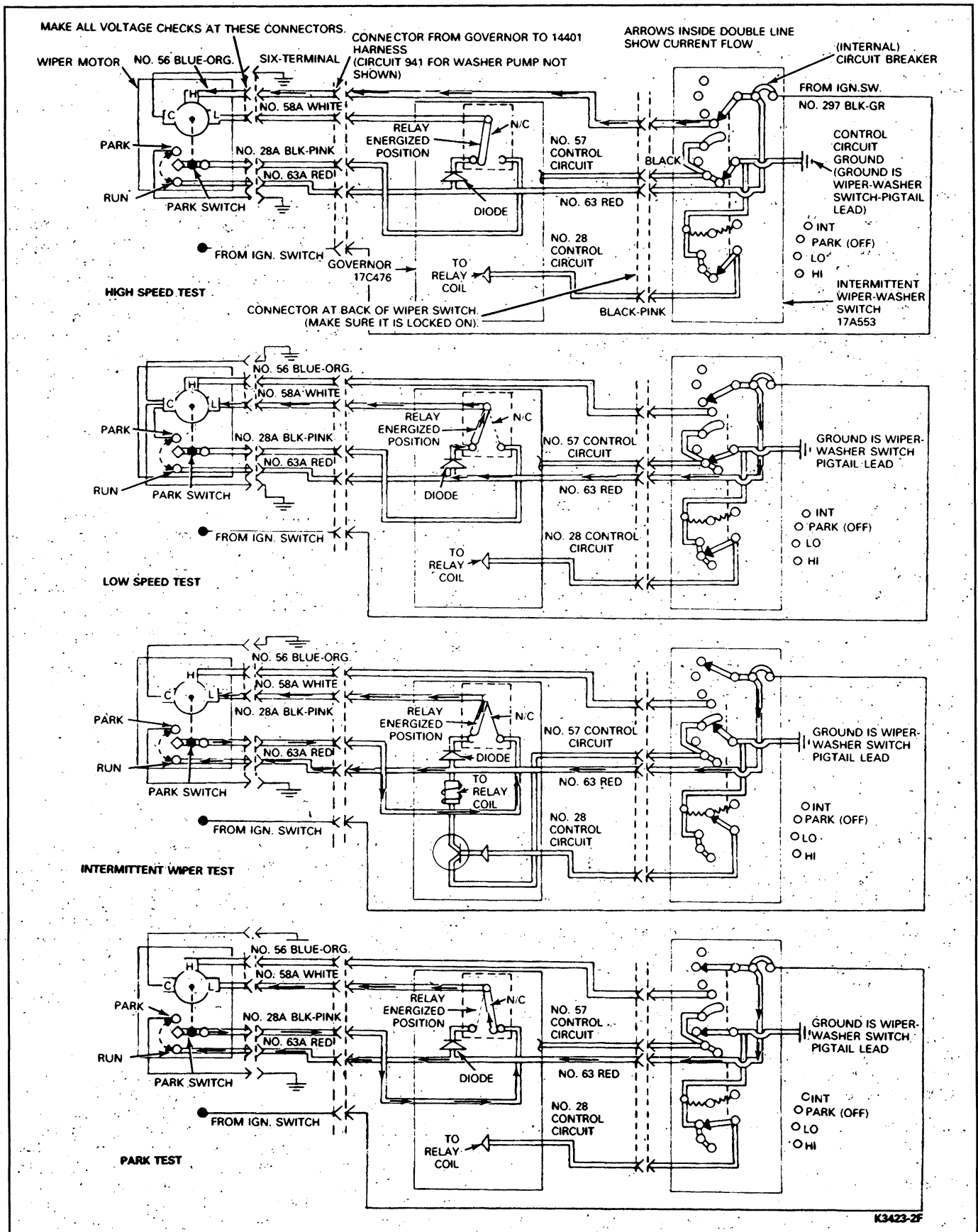


FIG. 3 Interval Windshield Wiper System "E" Motor Test—Bronco, F-150—F-350 and F-Super Duty

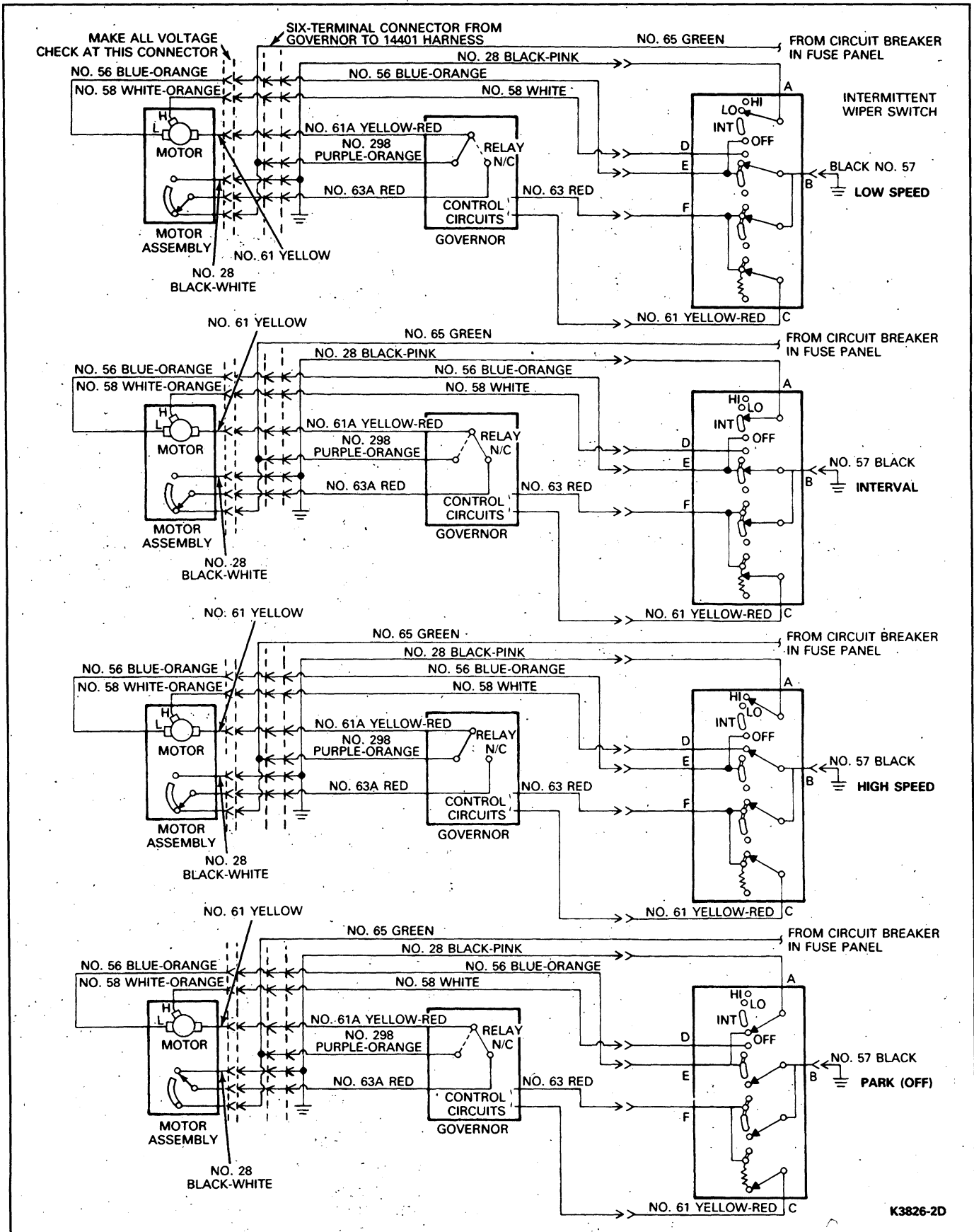


FIG. 4 Interval Windshield Wiper System "B" Motor Tests—E-150—E-350



## Standard Windshield Wiper System "B"

### Test E-150—E-350

#### High-Speed Test

NOTE: Perform all voltage checks at the wiper motor. If necessary, pierce the blue, white/orange and yellow wires.

With the wiper switch in the HI position, current flows from the ignition switch through the circuit breaker in the fuse panel, through the wiper switch contacts, through circuit 61 (yellow and red) to the wiper motor common brush. From the common brush, the current flows across the motor armature through circuit 58 white to the wiper switch and across the switch contacts to ground. The wiper motor is not grounded (Fig. 2).

To check high-speed operation, place ignition switch in ON position and wiper switch in the HI position. If voltage is present at circuit 61 pin at wiper motor connector and motor does not run, ground circuit 58. If motor runs with circuit 58 grounded, service wiper switch ground circuit or replace wiper switch. If motor does not run with circuit 58 grounded, repair motor. If voltage is present at circuit 65 (green) pin only, replace wiper switch. If no voltage is present at circuit 65 pin, trace circuit 65 to determine the source of problem.

#### Low-Speed Test

With the wiper switch in LOW position, current flows from ignition switch through circuit breaker in fuse panel, through circuit 61 (yellow) to the wiper motor common brush. From the motor common brush, current flows across the motor armature through circuit 56 (blue) to the wiper switch and across the wiper switch contacts to ground. The motor is not grounded.

To check low-speed operation, place ignition switch in ON position and wiper switch in LOW position. If voltage is present at circuit 61 pin at wiper motor connector and motor does not run, ground circuit 56. If motor runs with circuit 56 grounded, service wiper switch ground circuit or replace wiper switch. If wiper motor does not run with circuit 56 grounded, service motor. If voltage is present at circuit 65 pin only, replace wiper switch. If no voltage is present at circuit 65 pin, trace problem back to source of current.

#### Park-Operation Test

A set of contacts attached to circuit 63 inside the wiper motor oscillate between the circuit 65 and ground when the wiper motor is running (Fig. 2). When the wiper switch is turned off to park the wipers, the motor points are kept on the circuit 65 (battery voltage) for 9/10th of one cycle and at ground 1/10th of one cycle. Current flows from circuit 65 (green), through wiper motor park switch points and through the circuit 63 (red) to the wiper switch. From the wiper switch input the current flows across the wiper switch contacts, through circuit 61 circuit (yellow), through the common brush on the wiper motor out the low-speed brush on circuit 56 blue to the wiper switch. From the wiper switch input the current flows through switch contacts out circuit 28 (black/white) to ground.

To check park operation of wiper system, place ignition switch in ON position and wiper switch in OFF position. If wipers do not park, check for voltage at circuits 63 and 61 at wiper motor connector pins. If both pins show voltage, ground circuit 56. If motor parks, repair ground circuit or replace wiper switch. If motor does not run, replace the motor. If voltage is present at

circuit 63 but not at circuit 61, replace the wiper switch. If voltage is present at circuit 65 pin but not on circuit 63 pin, service wiper motor park switch. If no voltage is present at circuit 65 pin, trace problem back to source of current.

## Interval Windshield Wiper System "E"

### Motor Test F-150—F-350, F-Super Duty and Bronco

#### Quick Check

If wipers operate in high speed only (and wipers hesitate when going through PARK position), connect jumper wire from windshield wiper switch case to ground. If wipers now work in low speed, repair switch ground. If wipers do not work in low speed with switch case grounded, replace governor.

#### High-Speed Test

With the wiper switch in the HI position, current flows from the ignition switch through the wiper switch and governor, to the wiper motor, to ground (Fig. 3).

To check high-speed operation, place ignition switch in ON position and wiper switch in HI position. Check for presence of voltage at circuit 56 (blue/orange) pin. If voltage is present and motor does not run, ground motor ground circuit to body. If motor runs, repair motor ground circuit. If motor does not run, replace motor. If voltage is present at 63 pin (red wire) but not at pin 56 (blue/orange), replace the wiper switch. If no voltage is present at pin 63, remove wiper switch connector and check circuit 297 pin (black/green). If voltage is present, replace wiper switch. If not, trace circuit to determine source of problem.

#### Low-Speed Test

With wiper switch in LOW position, current flows from the ignition switch through the wiper switch and energized relay contacts of the governor, to the wiper motor (Fig. 3).

To check low-speed operation, place ignition switch in ON position and wiper switch in LOW position. Check for presence of voltage at circuit 58 pin. If voltage is present and wiper motor does not run, ground the motor ground circuit to the body. If motor runs, repair motor ground. If motor does not run, replace motor. If voltage is present at circuit 63 pin but not at circuit 58 pin, ground control circuits 57A (black) and 28A (black/pink) at wiper switch connector. If voltage is now present on circuit 58 pin, replace wiper switch. If voltage is not obtained at circuit 58 pin after grounding control circuits at wiper switch, replace governor. If no voltage is present at circuit 63 pin (red) remove the wiper switch connector and check for voltage at circuit 297 pin (black/green). If voltage is present, replace the wiper switch. If not, trace the circuit to determine source of problem.

NOTE: If governor relay is inoperative, wipers will operate in high speed and park only. Wipers will not operate in low and interval modes.

#### Interval Operation Test

When the wiper switch is placed in the INTERVAL mode, the wiper motor park switch contacts are at ground (assuming wipers started in PARK position), and the relay is energized (Fig. 3). Initially, current flows from the ignition switch through the circuit breaker in the wiper switch, through a diode and energized contacts in the governor, to the wiper motor low speed brush. The

motor rotates 1/10th of a cycle. The wiper motor park switch contacts then change from PARK (ground) to RUN (B+). After the contacts change position, the relay in the governor de-energizes. A second current path to the wiper motor is shown by the arrows in Fig. 3. The motor rotates through the remaining 9/10th of one cycle. When the park switch contacts again touch ground (PARK), the motor parks. The governor electronic circuit delays energizing of the relay until the circuit times out. Then the relay energizes and the low-speed interval is repeated. The discharge rate of a capacitor to ground through the wiper switch variable resistor controls the time delay of the system.

### Park Operation Test

When the wiper switch is placed in the OFF position, the wipers complete one full cycle through the wiper motor park switch. Current flows from the ignition switch across a circuit breaker in the wiper switch to the wiper motor park switch (run). From the park switch, current flows through the normally closed contacts of the governor relay (de-energized), to the wiper motor low-speed brush, across the armature and out a common brush to ground. This occurs for 9/10th of one cycle. At the last 1/10th of the cycle, the park switch moves from RUN to PARK, stopping the motor in PARK position.

To check park operation, place ignition switch in ON position and move wiper switch from operating mode to OFF position. Check for presence of voltage at circuit 58 pin. If voltage is present and motor does not park, ground the wiper motor ground circuit to the body. If motor parks, repair ground. If motor does not run, replace motor. If voltage is present at circuits 63 and 28 pins but not at circuit 58 pin, replace governor. If there is voltage on circuit 63 pin but not on circuit 28 pin, and the motor is not parked, replace the wiper motor. If no voltage is present on circuit 63 pin, remove the wiper switch connector and check for voltage at circuit 297 pin (black/green wire). If voltage is present, replace the wiper switch. If not, trace the circuit to determine source of problem.

NOTE: Before troubleshooting the interval operating mode, the wiper system must be performing properly in LOW and PARK modes. If the wipers run continuously at low speed; or the interval delay is excessive with the ignition switch on and the wiper switch in the INTERVAL position, remove the wiper switch and check continuity and resistance values (Fig. 10). If switch is OK, replace governor; otherwise replace the wiper switch.

### Interval Windshield Wiper System "B" Motor Test—E-150—E-350

NOTE: Perform all voltage checks at wiper motor. It may be necessary to pierce the blue, white/orange and yellow wires.

#### Low-Speed Test

With the wiper switch in the LOW position, the current flow is from the ignition switch through the circuit breaker through circuit 65 (green) to the governor as shown in Fig. 4. Refer to Section 34-31, Fuses, Circuit Breakers and Fuse Links. Placing the wiper switch in the LOW position causes the relay to be energized. This allows current to flow through the energized contacts of the governor and circuit 61 (yellow) to the common brush of the wiper motor. From the motor common brush, the current flows across the motor armature through circuit 56 (blue/orange) to the wiper switch and across the wiper switch contacts to ground.

To check low-speed operation, place the ignition switch in the ON position and wiper switch in LOW position. Check for presence of voltage at circuit 61 pin at the wiper motor connector. If the motor does not run, ground circuit 56. If motor runs with circuit 56 grounded, service wiper switch ground circuit or replace wiper switch. If motor does not run with circuit 56 grounded, replace motor. If voltage is **not** present at circuit 61, and circuit breaker is providing voltage, ground control circuits "F" (red wire) and pin "C" (yellow wire) at the wiper switch. If voltage is not obtained at circuit 61 pin at wiper motor, replace governor. If voltage is obtained at circuit 61 after grounding control circuit in wiper switch, replace wiper switch.

#### High-Speed Test

With the wiper switch in the HI position, current flows from the ignition switch through the circuit breaker in the fuse panel to the governor (circuit 65—green). The wiper switch grounds the control circuit, causing the relay to be energized. Current flows through the energized contacts of the governor through circuit 61 (yellow) to the common brush of the wiper motor. From the common brush, the current flows across the motor armature through circuit 58 (white/orange) to the wiper switch and through the wiper switch to ground.

To check high-speed operation, use the same procedures outlined for low-speed test except use circuit 58 instead of circuit 56.

#### Interval Operation Test

Before checking the INTERVAL operating mode, the wiper system must be operating normally in all other modes. Turn the ignition switch on and place the wiper switch in the INTERVAL position. If the wipers are running continuously at low speed or the time delay is excessive, remove the wiper switch and check continuity and resistance values (Fig. 9). If switch is OK, replace governor; otherwise replace wiper switch.

When the wiper switch is placed in the INTERVAL mode, the motor's oscillating park switch contacts are at ground (assuming wipers started in PARK position), and the governor relay is energized. Initially, current flows from the ignition switch (circuit 65—green) through the energized contacts in the governor to the wiper motor's low speed brush (circuit 61—yellow). The motor rotates 1/10th of a cycle. The wiper motor's oscillating park switch contacts then change from PARK (ground) to RUN (battery voltage). After the change in switch contact position, the relay in the governor de-energizes. A second current path to the wiper motor is completed by way of circuit 65 (green), the wiper motor oscillating park switch, circuit 63 (red), the normally closed contacts of the governor, and circuit 61 (yellow). The motor rotates through the remaining 9/10th of one revolution. When the oscillating park switch contacts again touch ground (PARK), the motor parks. The interval windshield wiper governor's electronic circuit delays energizing of the relay until the circuit times out; then the relay energizes and the low-speed interval cycle is repeated. The discharge rate of a capacitor to ground through the wiper switch variable resistor controls the time delay of the system.

#### Park Operation Test

With the wiper switch in the OFF position, the wipers will complete one cycle through the wiper motor's park switch. Current flows from the ignition switch, across the circuit breaker in the fuse panel, to the wiper motor's

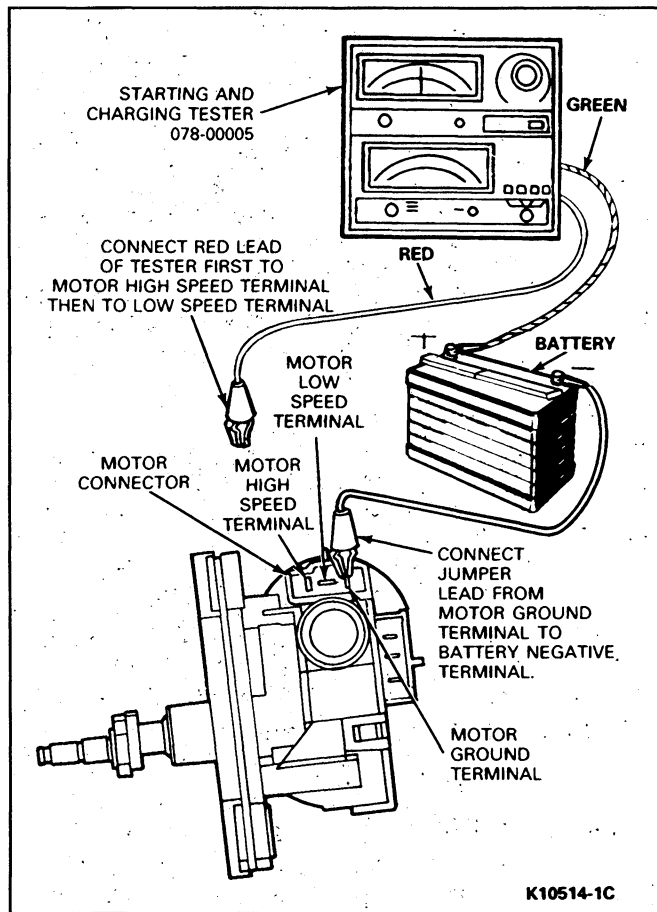


FIG. 5 Wiper Motor Current Draw Test—"E"—F-150—F-350, F-Super Duty and Bronco

oscillating park switch (run). Then, current flows from the park switch through the normally closed governor relay contacts (de-energized) to the motor's common brush, across the motor armature, and out the low-speed brush to ground. This occurs for 9/10th of one cycle. At the last 1/10th of the cycle, the oscillating park switch moves from the RUN position to ground (PARK), stopping the motor in the PARK position.

To check park operation, place the ignition switch in the ON position and move the wiper switch from an operating mode to the OFF position. Check for presence of voltage at circuit 61 (yellow) pin. If voltage is present and the motor does not park, ground circuit 56 (blue). If the motor parks, repair ground circuit or replace wiper switch. If motor does not run, replace motor. If voltage is present at circuits 65 (green) and 63 (red) pins but not at circuit 61 pin, replace the governor. If voltage is present on circuit 65 pin, but not on circuit 63 pin, repair the motor park switch. If no voltage is present on circuit 65 pin, trace circuit back to determine source of problem.

### Wiper Motor Current Draw

See Figs. 5 through 10.

**CAUTION:** Electric wiper motors contain permanent magnets made of ceramic. This is a hard glass-like material that can shatter or crack if the motor receives a severe physical shock. Do not handle any windshield wiper motor abusively when diagnosing wiper operations, because it will damage the magnets and make the motor

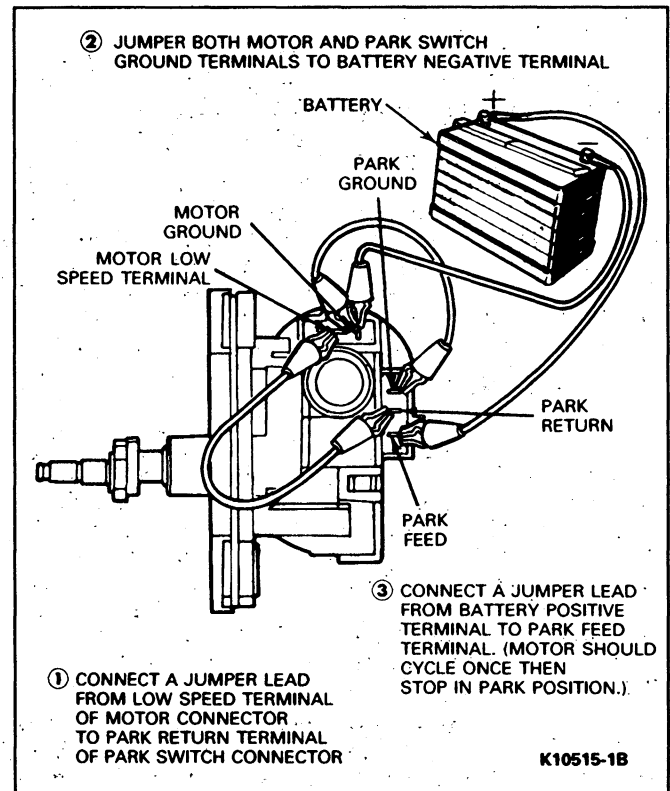


FIG. 6 Park Switch Test—F-150—F-350, F-Super Duty and Bronco

inoperative. Rough handling of new replacement motors may also damage the magnets.

### Bronco, F-150—F-350 and F-Super Duty

The windshield wiper motor tests can be performed with the wiper motor installed in the vehicle (linkage disconnected), or on the bench.

1. Disconnect positive cable from battery.
2. Disconnect wiper linkage from wiper motor.
3. Disconnect electrical plug to test motor on vehicle.
4. Connect the green lead from the tester to the battery positive post.
5. Connect the positive (red) lead from the tester first to the low-speed connection and then to the high-speed connection at the connector plug. In either case, the current draw should not exceed 3.5 amperes.

### E-150—E-350

The windshield Wiper Motor Tests can be performed with the wiper motor installed in the vehicle (linkage disconnected), or on the bench.

1. Disconnect positive cable from battery.
2. Connect the positive (red) lead from the tester to the common brush terminal on the motor end plate.
3. Connect the green lead from the tester to the battery positive post (Fig. 7).
4. Connect a jumper wire from the battery negative post first to the low-speed terminal on the motor end plate and then to the high speed terminal and read current draw. In either case the current draw should not exceed 3.5 amperes.

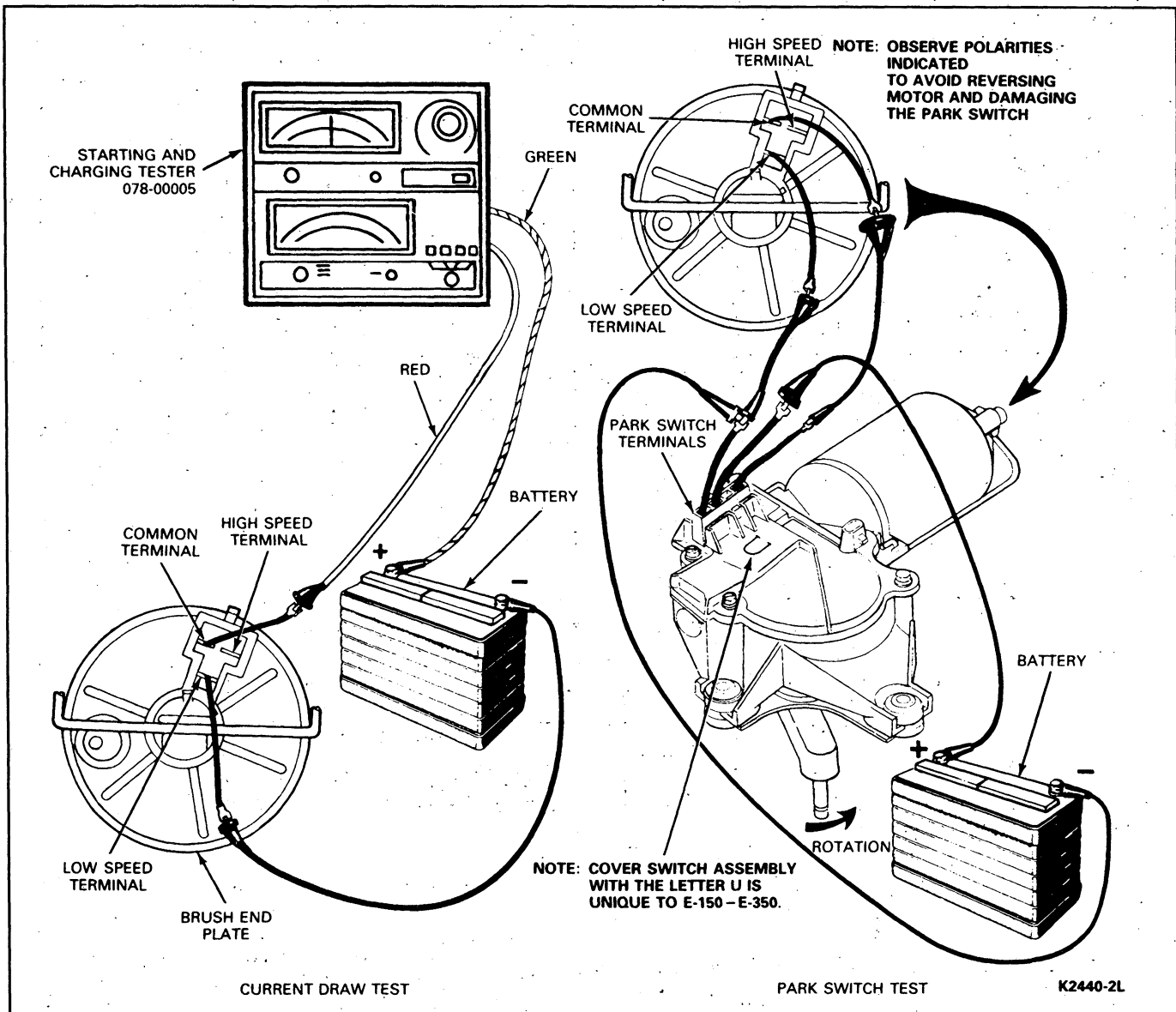


FIG. 7 Wiper Motor Tests—"B"—E-150—E-350

5. If the current draw exceeds 3.5 amperes check the output arm for binding or damage before replacing motor.

#### Circuit Breaker Test—F-150—F-350, F-Super Duty and Bronco Only

The circuit breaker is rated at 7 amps and is located in the wiper control switch on all rotary switches.

Two separate tests are necessary to check for correct circuit breaker operation when circuit breaker is part of wiper switch (Fig. 8).

##### Test 1

1. Before connecting the switch to the Rotunda Digital Volt-Ohmmeter 007-00001 or equivalent (Fig. 8), short the tester leads together and adjust the current draw until it equals the circuit breaker rating.
2. Connect the switch to the tester (Fig. 8). Leave the switch connected to the tester for ten minutes. Hold the current reading on the ammeter at the rated current. If the circuit breaker opens during

the ten minutes, replace the wiper switch assembly.

##### Test 2

1. Short the tester leads together and adjust the current draw until it is twice the rated current.
2. Connect the switch. Hold the current reading on the ammeter at twice rated current. The current reading on the ammeter should drop to zero within 20 seconds. If it takes longer than 20 seconds for the circuit breaker to open (current reading drops to zero), replace the wiper switch assembly.

#### Wiper Switch Continuity Test

Check for continuity between the switch terminals (Figs. 9 and 10). Either a self-powered test lamp or an ohmmeter can be used to test standard two-speed switch. An ohmmeter must be used to test switch used with the interval wiper system.

To detect marginal operation of the switch, rotate or slide the switch control knob while each reading is being taken.

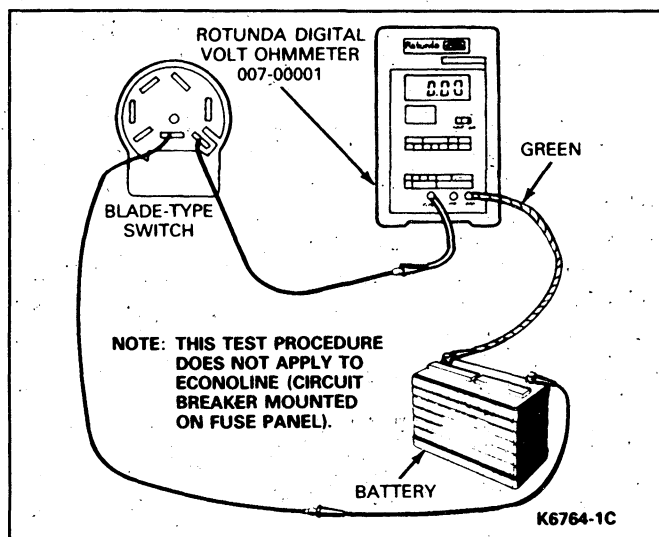


FIG. 8 Circuit Breaker Test

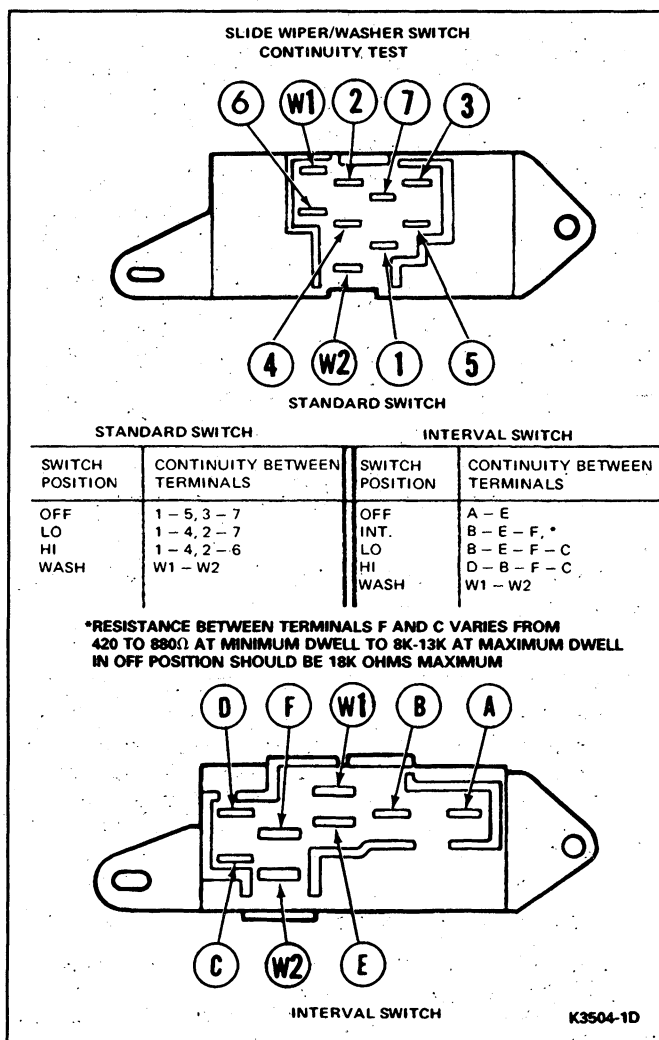


FIG. 9 Wiper Switch Continuity Test—E-150—E-350

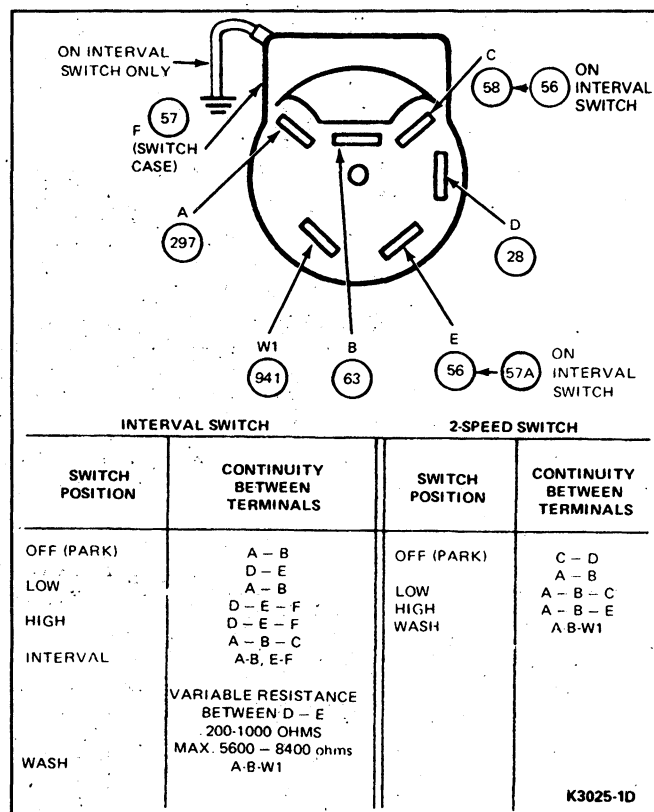


FIG. 10 Wiper Switch Continuity Test—Bronco, F-150—F-350 and F-Super Duty

If the switch does not exhibit continuity, or if poor continuity exists in any switch position, replace the switch.

### Windshield Wiper Interval Governor Test

If interval operation is unsatisfactory, first check the motor current draw. Then check the control switch and all connecting wires for continuity. If the motor, switch and connecting wires are OK, replace the electronic governor.

### Diagnosis Guides

Refer to the Diagnosis Guide in this Section to isolate problems in the windshield wiper system.

### ADJUSTMENTS

#### Arm and Blade Assembly

Remove the arm and blade assemblies from the pivot shafts. Turn on the wiper switch to allow the motor to move the pivot shafts three or four cycles, and then turn off the wiper switch. This will place the pivot shafts in PARK position.

Install the arm and blade assemblies on the pivot shafts to Dimension X as shown in Fig. 11. Dimension X is the distance between the centerline of the blade saddle and the windshield lower moulding or weatherstrip. The value of Dimension X for each vehicle is given in Fig. 11.

## REMOVAL AND INSTALLATION

### Wiper Motor

#### F-150—F-350, F-Super Duty and Bronco

NOTE: The wiper motor is not serviceable. It must be replaced as a complete assembly.

#### Removal

1. Disconnect the battery ground cable.
2. Remove both wiper arm and blade assemblies (Fig. 12).
3. Remove the cowl grille attaching screws and lift the cowl grille slightly.
4. Disconnect the washer nozzle hose and remove the cowl grille assembly.






5. Remove the wiper linkage clip from the motor output arm.
6. Disconnect the wiper motor wiring connector.
7. Remove the wiper motor's three attaching screws and remove the motor.

#### Installation

1. Install the motor and attach the three attaching screws (Fig. 12). Tighten to 6.7-9.5 N·m (60-85 in-lb).
2. Connect wiper motor wiring connector.
3. Install wiper linkage clip to the motor output arm.
4. Connect the washer nozzle hose and install the cowl assembly and attaching screws.
5. Install both wiper arm assemblies as outlined.

### Diagnosis Guides

#### WINDSHIELD WIPERS DO NOT PARK

TEST STEP		RESULT	ACTION TO TAKE
1.0	DURING OPERATION WHEN WINDSHIELD WIPERS ARE TURNED OFF WIPERS DO NOT PARK		
1.1	PERFORM MOTOR PARKING SWITCH TEST		
<ul style="list-style-type: none"> <li>Perform motor parking switch test (as described in this section).</li> </ul>		Parking switch test 	REMOVE wiper motor from the vehicle and repair parking switch as required.
		Parking switch test 	GO to 1.2.
1.2	CHECK CONTINUITY OF WIPER SWITCH		
<ul style="list-style-type: none"> <li>Perform wiper switch continuity test (as described in this section).</li> </ul>		Continuity test 	REPLACE wiper switch.
		Continuity test 	GO to 1.3.
1.3	CHECK WIRING		
<ul style="list-style-type: none"> <li>Check wiring between the wiper switch and the motor.</li> </ul>		Wiring damaged	REPAIR wiring as required.
		Wiring 	For interval wiper systems, substitute known good interval windshield wiper governor.

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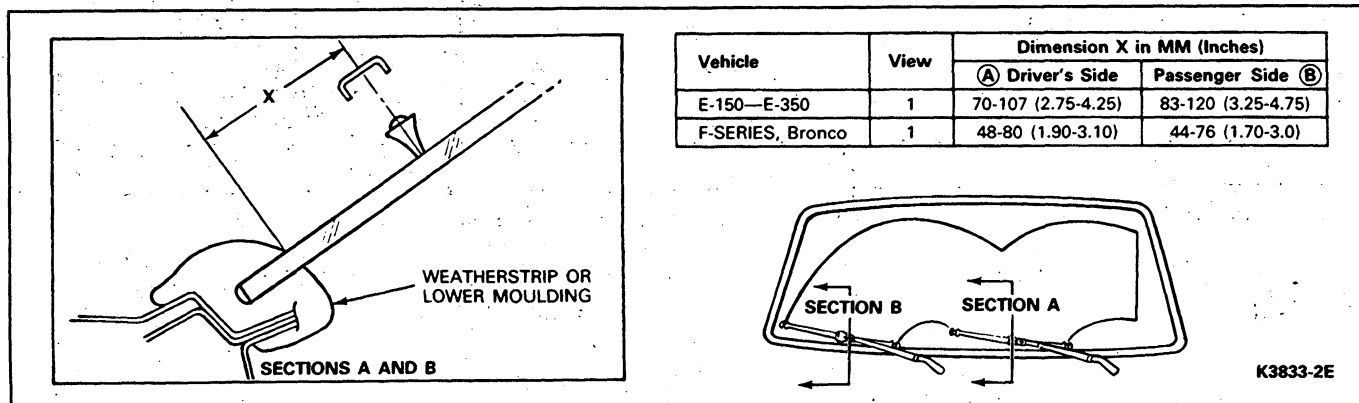


FIG. 11 Wiper Arm and Blade Adjustment to Dimension "X"

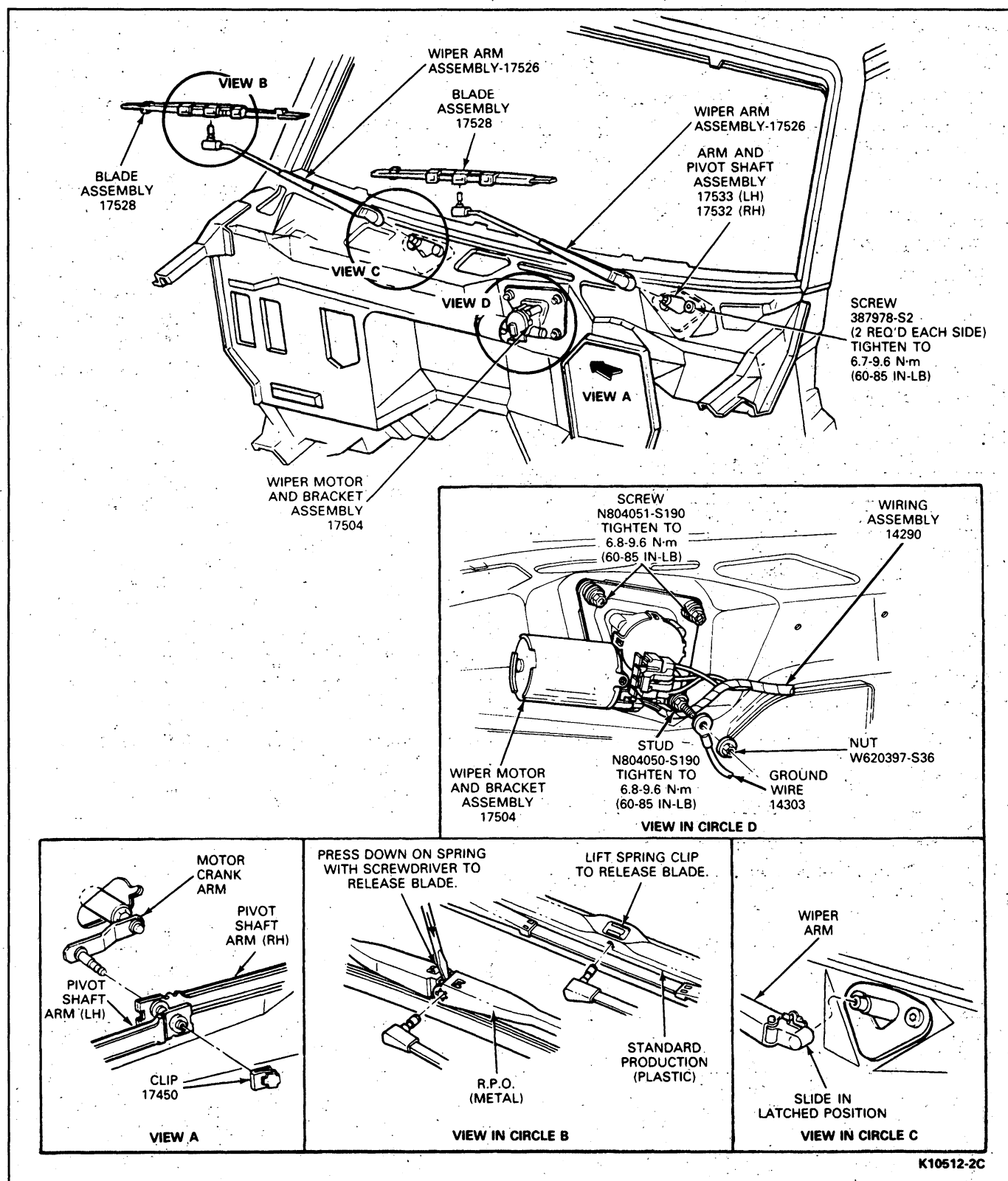


FIG. 12 Windshield Wiper Motor Installation—F-150—F-350, F-Super Duty and Bronco

6. Connect battery ground cable.

**E-150—E-350**

#### Removal

1. Disconnect the battery ground cable. Remove the fuse panel and bracket assembly.
2. Disconnect wiper motor wiring harness connector at the motor brush cap and gear box cover (Fig. 13).
3. Remove the wiper arm and blade assemblies from the pivot shaft.

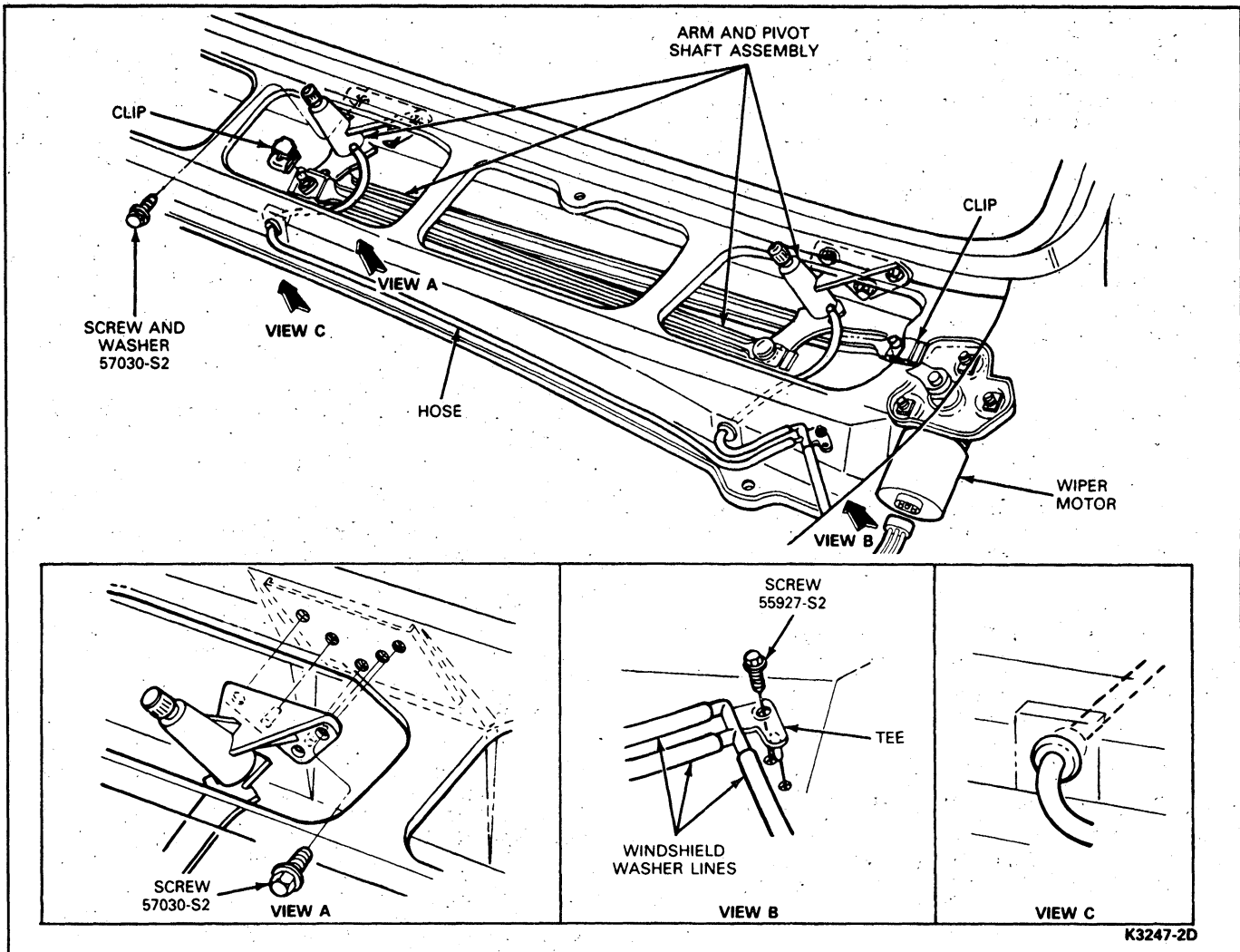


FIG. 13 Windshield Wiper Motor, Linkage, and Pivot Shaft Installation—E-150—E-350

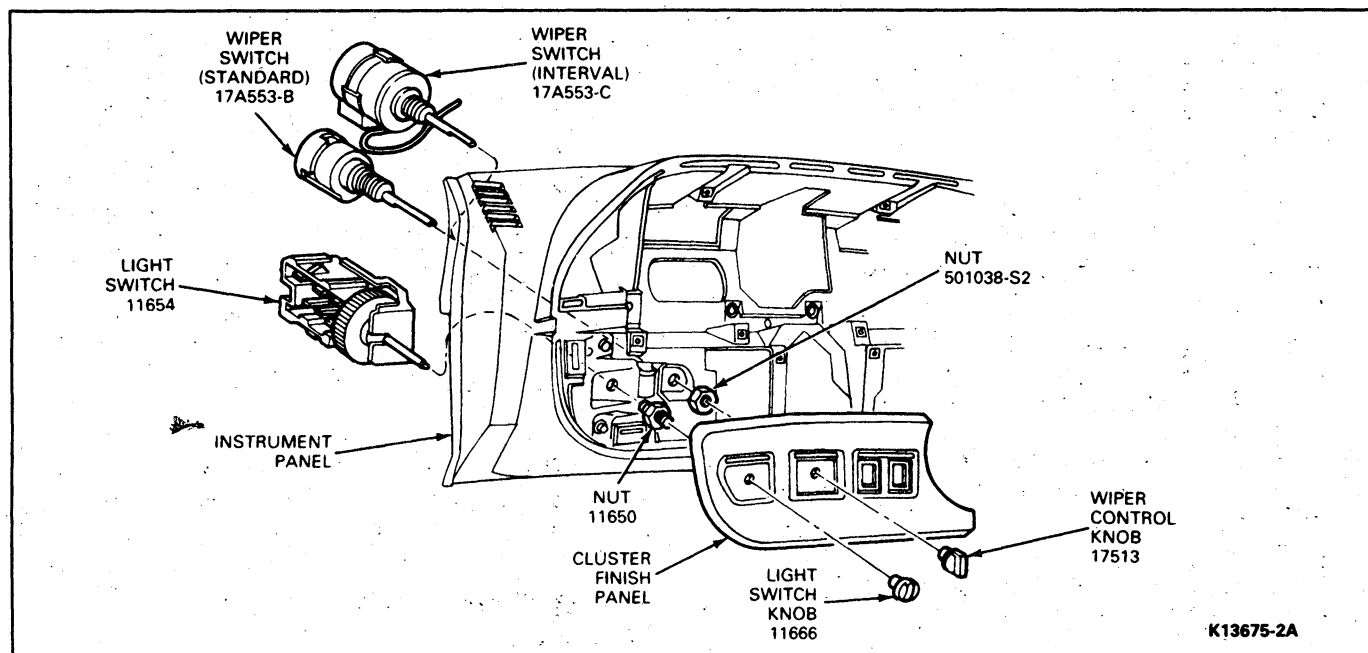


FIG. 14 Wiper Control Switch—F-150—F-350, F-Super Duty and Bronco



4. Remove the outer air inlet cowl. Remove the clip retaining the motor drive arm to the linkage mounting arm and pivot shaft assembly (Fig. 13).
5. Remove the wiper motor attaching bolts and remove the motor.

### Installation

1. Check the new motor to ensure it is in the PARK position.
2. Install the motor to the inner dash panel. Tighten the attaching bolts 6.7-9.5 N·m (60-85 in-lb).
3. Install the wiper arm and blade assemblies on the pivot shaft as outlined.
4. Connect the linkage mounting arm and pivot shaft assembly to the motor drive arm and install the retaining clip.
5. Install the outer air inlet cowl.
6. Connect the motor wiring harness connector to the motor brush cap and gear box cover. Connect the ground cable to the battery. Install the fuse panel and bracket. Check operation of the wipers.

### Wiper Control Switch

NOTE: The switch handle is an integral part of the switch and cannot be removed separately.

#### F-150—F-350, F-Super Duty and Bronco

##### Removal

1. Disconnect the battery ground cable.
2. Remove the wiper switch knob, bezel nut, and bezel (Fig. 14).
3. Pull out the switch from under the instrument panel. Disconnect the electrical connector from the switch and remove the switch.

##### Installation

1. Position the switch and connect the electrical connector.
2. Position the switch in the instrument panel and install the bezel, bezel nut, and knob.
3. Connect the battery ground cable and check the operation of the switch.

#### E-150—E-350

##### Removal

1. Disconnect the battery ground cable.
2. Remove the windshield wiper switch knob.
3. Remove the ignition switch bezel (Fig. 15).
4. Remove the headlamp switch knob and shaft by pulling the switch to headlamp ON position. Then, depress button on top of switch and pull knob and shaft out of headlamp switch.
5. Remove two screws at bottom of finish panel. Then, carefully pry the two upper retainers away from the instrument panel assembly.
6. Disconnect the connector from the wiper switch.
7. Remove the wiper switch attaching screws and remove the switch.

##### Installation

1. Install the wiper switch to the finish panel (two screws).

2. Install the connector to the wiper switch.
3. Position the ignition switch to the finish panel and install the retaining bezel.
4. Position the headlamp switch to the finish panel, install the retaining bezel and snap in the headlamp shaft and knob. Install the wiper switch knob.
5. Position the finish panel to the instrument panel and snap in the upper retaining clips.
6. Install two bottom finish panel retaining screws.
7. Install the battery ground cable. Check operation of the wipers.

### Interval Governor

#### F-150 Through F-350, F-Super Duty, Bronco and E-150—E-350

##### Removal

1. Disconnect the electrical connectors from the governor and remove locator from instrument panel reinforcement.
2. Remove the governor attaching screw (Fig. 16), and remove the governor.

##### Installation

1. Position the governor to the instrument panel flange, and install the attaching screw.
2. Connect the electrical connectors and locator to the instrument panel reinforcement. Check operation of the wiper system.

### Arm and Blade Assembly-To-Pivot Shaft

##### Removal and Installation

Raise the blade end of the arm off of the windshield and move the slide latch (Fig. 17) away from the pivot shaft. This will unlock the wiper arm from the pivot shaft and hold the blade end of the arm off of the glass at the same time. The wiper arm can now be pulled off of the pivot shaft without the aid of any tools. (Disconnect the washer hose at the wiper arm head on E-150—E-350 only.)

To install, connect the washer hose at the wiper arm head (E-150—E-350 only) and push the main arm head over the pivot shaft. Be sure that the pivot shaft is in PARK position as outlined, and that the blade assembly is correctly positioned (Fig. 11). Hold the main arm head onto the pivot shaft while raising the blade end of the wiper arm and push the slide latch into the lock under the pivot shaft head. Then, lower the blade to the windshield. If the blade does not touch the windshield, the slide latch is not completely in place.

### Rubber Element To Wiper Blade

##### Removal and Installation

The rubber element in all blades can be replaced.

If the arm or blade assembly is bent or distorted, replace the complete blade assembly. Refer to Figs. 18 and 19 for procedures.

### Pivot Shaft and Linkage

#### E-150—E-350

##### Removal

1. Disconnect the battery ground cable.

2. Remove the wiper blade and arm assembly from the pivot shaft and disconnect the washer hose (Fig. 13).
3. Remove the cowl grille.
4. Remove the clip securing the LH and RH linkage. Remove the clip from the wiper motor arm (Fig. 13).
5. Remove three pivot body-to-cowl panel screws and remove the arm and pivot shaft assembly.

### Installation

1. Position the arm and pivot shaft assembly to the cowl panel and install the three attaching screws.
2. Install the clip to the LH and RH linkage and the clip linkage to motor arm (Fig. 13).
3. Install the cowl grille and washer hoses to the wiper blade and arm. Install the wiper blade and arm assembly as outlined.
4. Connect the battery ground cable and check the operation and adjustment of the wipers.

### F-150—F-350, F-Super Duty and Bronco

Refer to Fig. 19.

### Removal

1. Disconnect the battery ground cable.
2. Remove both wiper arm assemblies.
3. Remove the cowl grille attaching screws and lift the cowl grille slightly.
4. Disconnect the washer nozzle hose and remove the cowl grille assembly.

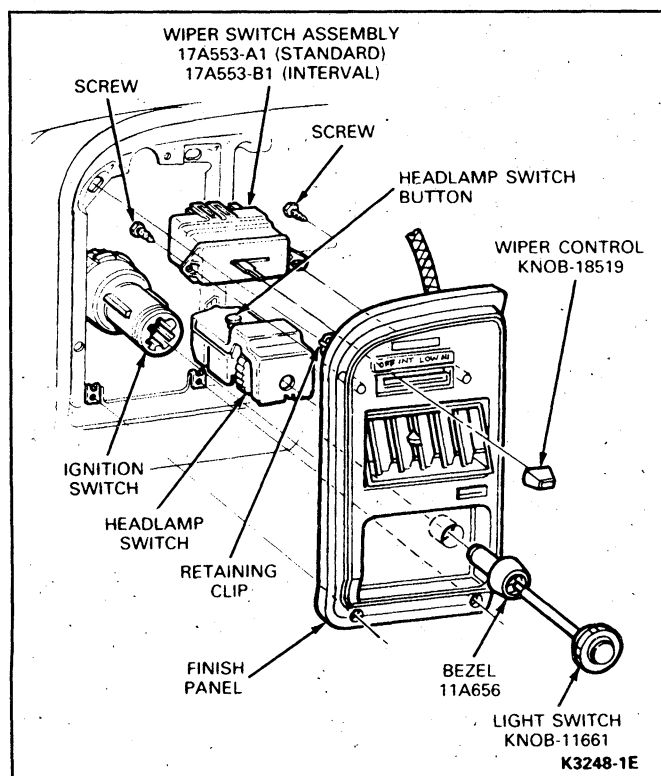


FIG. 15 Windshield Wiper Control Switch Installation—E-150—E-350

5. Remove the wiper linkage clip from the motor output arm and pull the linkage from the output arm (Fig. 18).
6. Remove the pivot body-to-cowl screws and remove the linkage and pivot shaft assembly (three screws on each side). The LH and RH pivots and linkage are independent and can be serviced separately.

### Installation

1. Attach the linkage and pivot shaft assembly to cowl with attaching screws.
2. Replace the linkage to the output arm and attach the linkage clip.
3. Connect the washer nozzle hose and cowl grille assembly.
4. Attach cowl grille attaching screws.
5. Replace both wiper arm assemblies as outlined.
6. Connect battery ground cable.

### DISASSEMBLY AND ASSEMBLY

The wiper motor service parts (except wiper system "E" motor) for F-150—F-350, F-Super Duty, Bronco and E-150—E-350 are only available in kits of the major subassemblies. The following Removal and Installation procedures apply to the kits.

### Cover and Switch Assembly

#### E-150—E-350

NOTE: The E-150—E-350 switch assembly is identified by the letter "U" stamped on the outside surface with ink.

Remove the four cover retaining screws to remove the assembly. Replace with the appropriate kit. Be sure to assemble the ground strap under the cover screw. On all except E-150—E-350, use the new screws supplied with the kit. Tighten to 1.69-2.82 N·m (15-25 in-lb).

### Brush End Plate

#### E-150—E-350

Carefully observe the original position of the bail retainer and pry it off with a screwdriver. Remove the end plate and plug. Replace it with the appropriate kit (Fig. 20).

NOTE: The E-150—E-350 switch assembly is identified by the letter "U" stamped on the outside surface with ink.

When installing the end plate, use a fine-wire probe through the hub opening to position the brushes on the commutator. Rotate end plate to position the key in the notch and assemble the plug. Install the bail retainer carefully with a screwdriver to avoid overbending.

### CLEANING AND INSPECTION

1. Clean all old grease from gear housing. Do not allow any cleaning fluid to contact the armature shaft and output shaft bearings.
2. Wipe all other parts with a clean cloth.
3. Inspect the gear housing for cracks or distortion. Replace a cracked or distorted housing.
4. Check all shafts, bushings, and gears for scored surfaces. Replace damaged parts, and add new

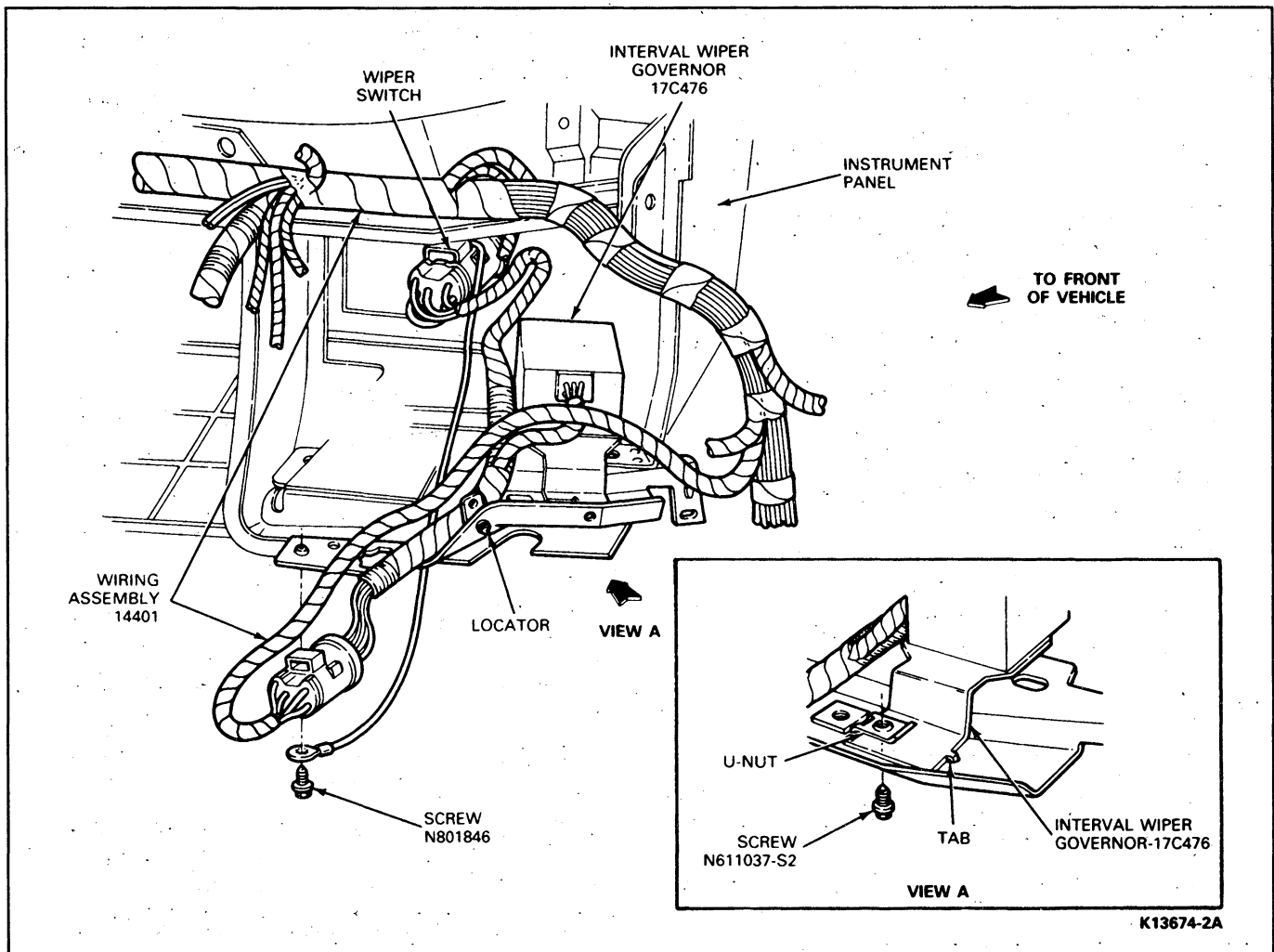


FIG. 16 Windshield Wiper Interval Governor—Typical (F-Series and Bronco Shown)

ESF-M1C149-A grease or equivalent to the housing and gears.

## MAINTENANCE

### Windshield Wiper Blades

If the windshield wiper blade assembly is equipped with a yellow or orange plastic sleeve, it is to be removed just prior to delivery of the vehicle to the customer.

To maintain maximum wiper effectiveness after the sleeves are removed, the windshield and wiper blades must be kept clean. Foreign matter on the windshield or wiper blades may cause streaking, chattering or smearing. If blades do not clean properly, wash the wiper blades with a clean towel and complete windshield area with undiluted Ford Ultra-Clear Windshield Washer Concentrate C9AZ-19550-AA or BA or equivalent. Wash thoroughly and repetitively until all the foreign matter and contamination is removed. Rinse with water while rubbing with a clean cloth. Lift the blades off the windshield to clean them. For access to hidden blades, turn ignition to ACC position with the wipers on. When wiper blades are approximately vertical, turn ignition off.

If streaking, chattering or smearing persists, repeat the above procedure.

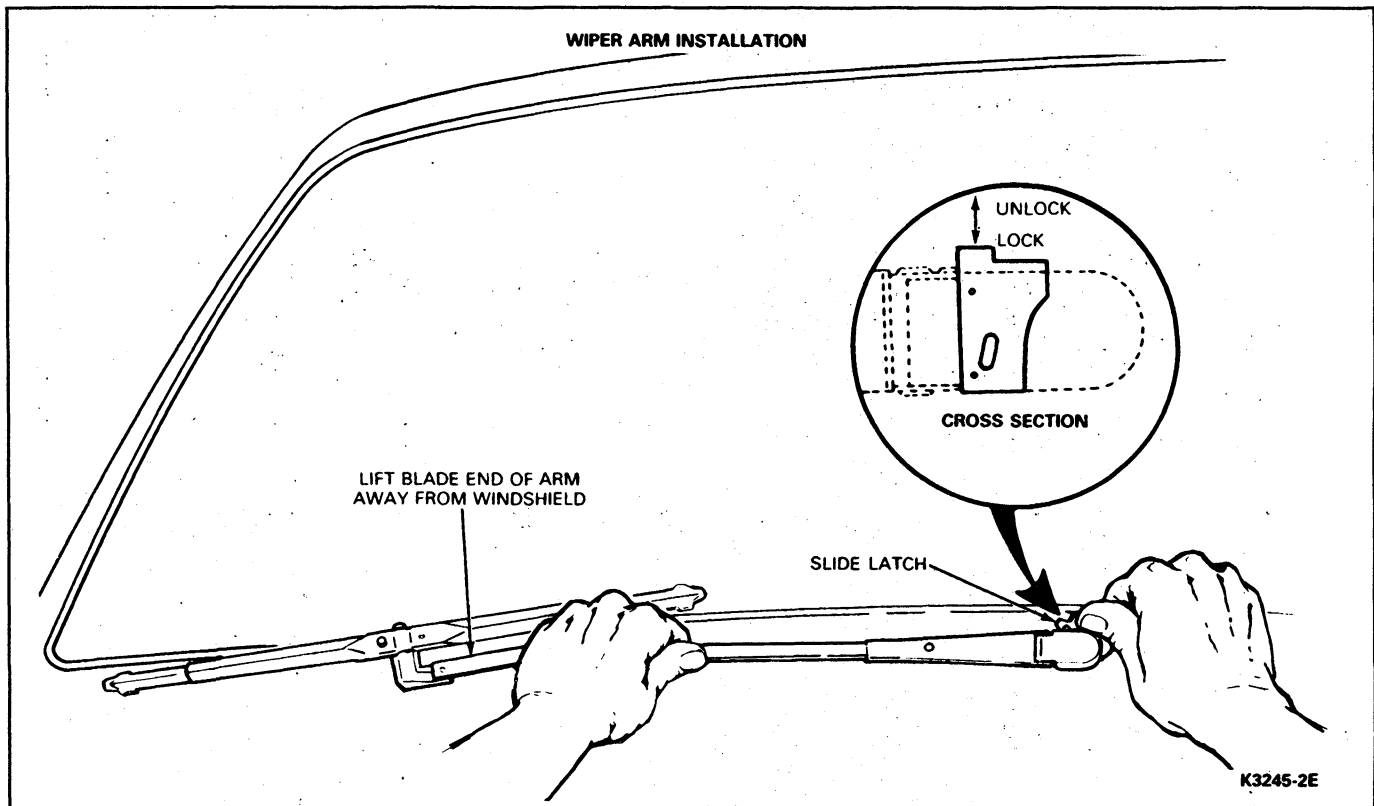
**CAUTION:** Do not allow wiper blade rubber elements to come in contact with oil, gasoline, kerosene, paint thinner or similar solvents. The elements are damaged by these solvents and must be replaced.

### Windshield Wiper Blade Replacement

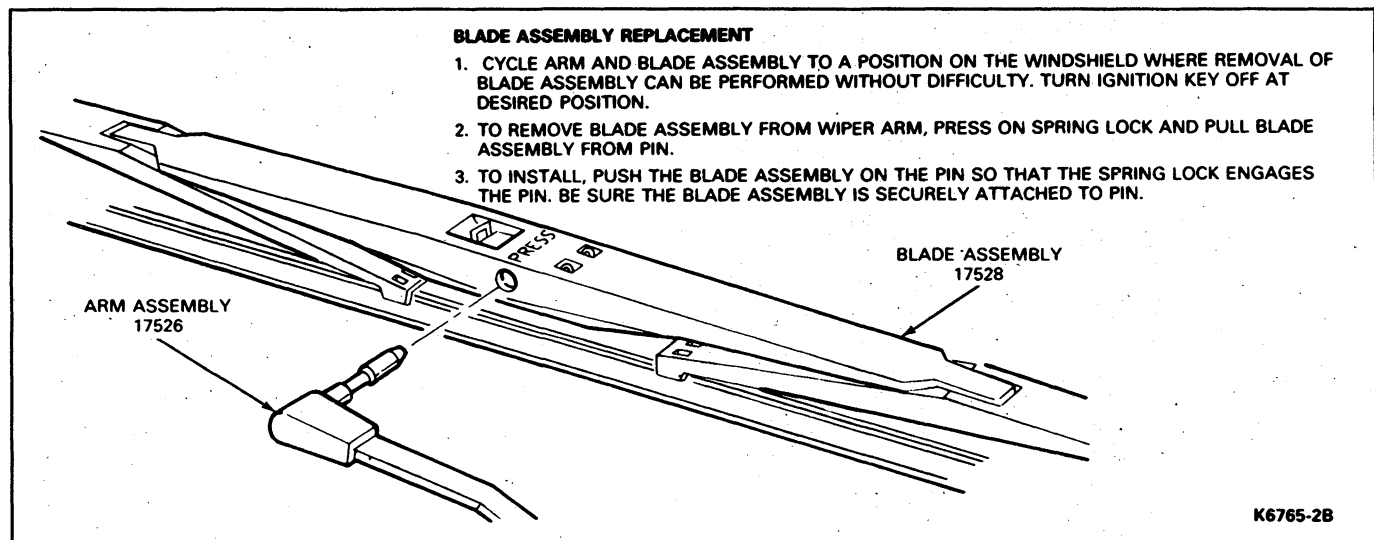
Wiper blade replacement intervals will vary with the amount of use, type of weather, chemical reaction from road tars or salts and the age of the blades. Be sure that the windshield glass surface is not contaminated with oil, tree sap or other substance which cannot be easily rubbed off.

Generally, if the wiper pattern across the glass is uneven and streaks over clean glass, the blades should be cleaned.

If cracks or breaks are found in the rubber, replace wiper blade, as outlined in this Section.



**FIG. 17 Wiper Arm Installation—E-150—E-350, F-150—F-350, F-Super Duty and Bronco**



**FIG. 18 Tridon Blade and Element Replacement**

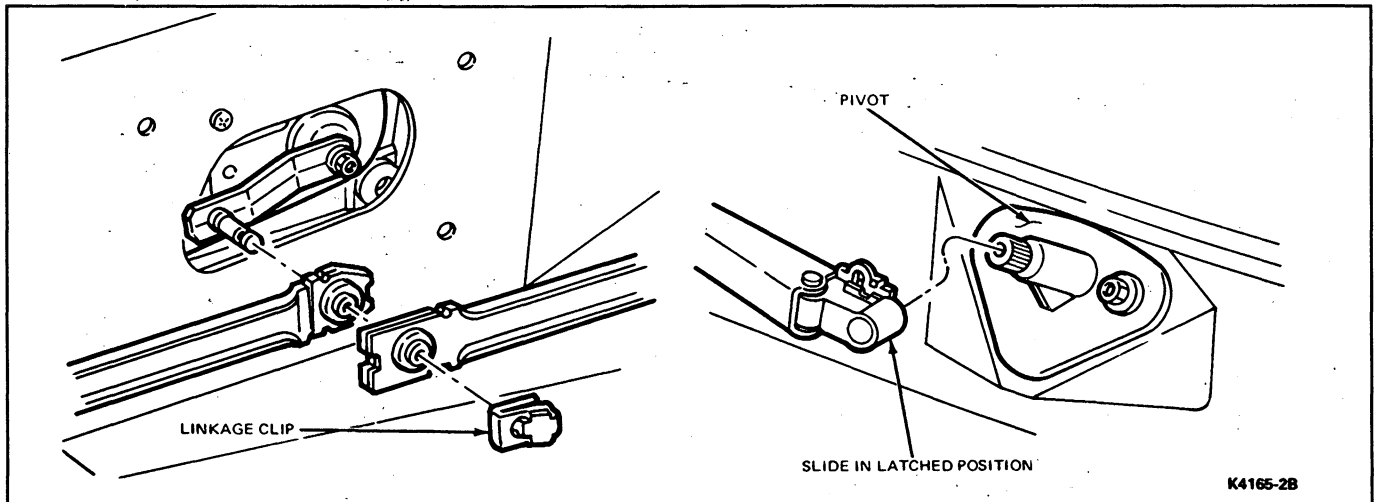


FIG. 19 Linkage and Pivot Shaft Installation—F-150—F-350, F-Super Duty and Bronco

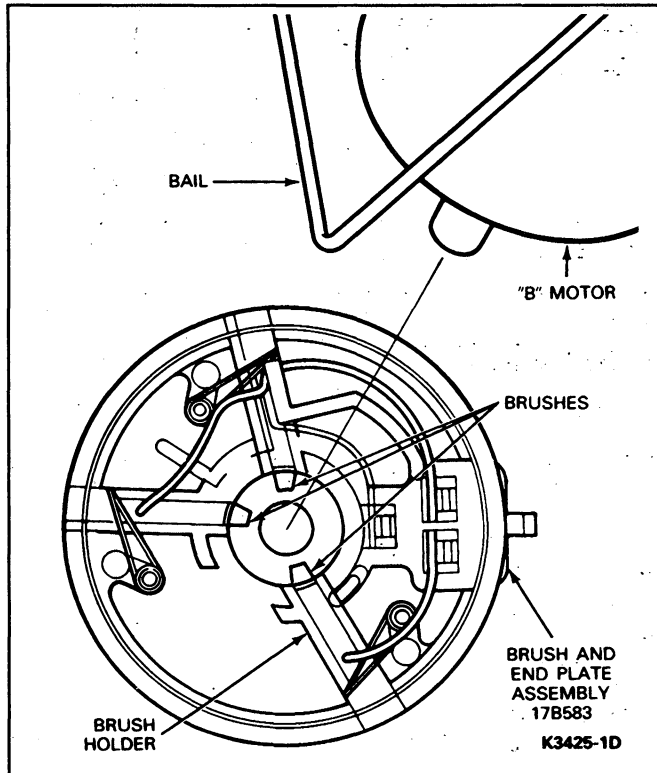


FIG. 20 "B" Motor Brush End Plate Assembly—E-150—E-350

**SPECIFICATIONS****ELECTRIC WINDSHIELD WIPER MOTOR AND SWITCH TEST CURRENT LIMITS**

Motor Type	Motor Current* Draw Test	Circuit Breaker/Switch Low Current Pass Test	Circuit Breaker/Switch High Current Pass Test
System "E" — F-Series and Bronco	3.5 amperes	7 amperes	14 amperes
System "B" — E-Series	3.5 amperes	7.5 amperes	15 amperes

\*Motor maximum current when operated without linkage attached.

CK2501-2N

**SPECIAL SERVICE TOOLS****ROTUNDA EQUIPMENT**

Number	Description
007-00001	Digital Volt Ohmmeter
078-00005	Starting and Charging Tester

CK8983-1A

## SECTION 35-70 Windshield Washers

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>DIAGNOSIS GUIDES</b> .....	35-70-2
Washer Nozzle .....	35-70-3	<b>REMOVAL AND INSTALLATION</b>	
E-150—E-350 .....	35-70-3	Jets .....	35-70-4
F-150—F-350, F-Super Duty and Bronco .....	35-70-3	E-150—E-350 .....	35-70-4
<b>DESCRIPTION AND OPERATION</b>		F-150—F-350, F-Super Duty and Bronco .....	35-70-4
Washer System—Electric .....	35-70-1	Motor, Seal and Impeller Assembly .....	35-70-3
<b>DIAGNOSIS AND TESTING</b>		Windshield Washer Reservoir And Motor Assembly .....	35-70-3
Washer Pump Current Draw Test .....	35-70-1	<b>SPECIAL SERVICE TOOLS</b> .....	35-70-4
Washer Switch .....	35-70-1	<b>VEHICLE APPLICATION</b> .....	35-70-1
Washer System .....	35-70-1		

### VEHICLE APPLICATION

All Models.

### DESCRIPTION AND OPERATION

#### Washer System—Electric

The electric windshield washer system consists of an instrument panel control switch, integral with the wiper control switch, reservoir and motor assembly, and the necessary hoses, nozzles and attaching parts.

### DIAGNOSIS AND TESTING

#### Washer Pump Current Draw Test

Attach the leads of the Digital Volt-Ohmmeter 007-00001 as shown in Fig. 1. The current draw should not exceed four amps nor be less than 1.7 amps while the washer pump is pumping fluid.

#### Washer Switch

The windshield washer switch is an integral part of the windshield wiper switch. Refer to Section 35-60, Windshield Wipers — Electric for windshield wiper/washer switch testing.

#### Washer System

Refer to the Diagnosis Guide to isolate problems in the windshield washer system.

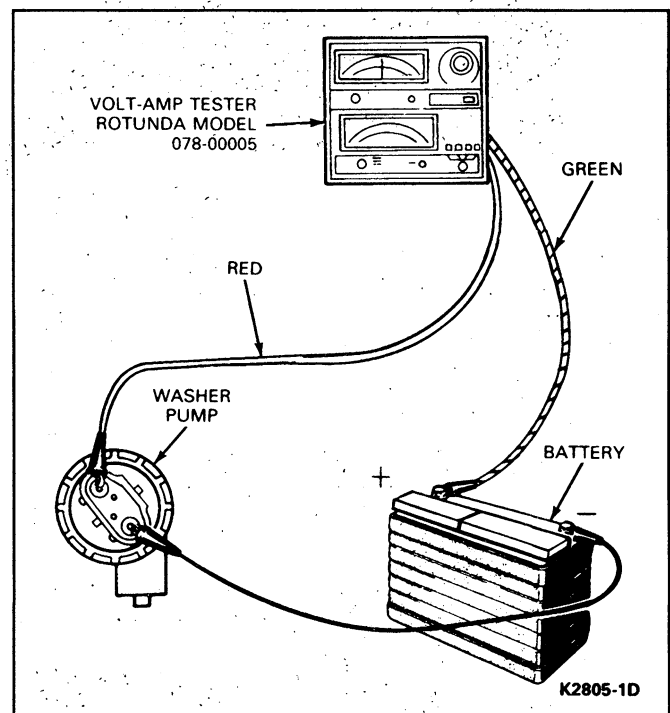






FIG. 1 Washer Pump Current Draw Test

## DIAGNOSIS GUIDES

Use the following guides to isolate problems in the windshield washer system:









### WINDSHIELD WASHER DOES NOT WORK

TEST STEP		RESULT	ACTION TO TAKE
<b>1.0</b>	<b>DURING OPERATION WINDSHIELD WASHER DOES NOT WORK</b>		
<b>1.1</b>	<b>CHECK FLUID LEVEL</b>		
	<ul style="list-style-type: none"> <li>Check fluid level of washer.</li> </ul>	No fluid Fluid level 	FILL washer reservoir and CHECK operation of washers. GO to 1.2.
<b>1.2</b>	<b>CHECK WIPER OPERATION</b>		
	<ul style="list-style-type: none"> <li>Check operation of windshield wiper.</li> </ul>	Wipers do not work. Wipers do work	GO to 1.3. GO to 1.4.
<b>1.3</b>	<b>CHECK HEATER BLOWER AND RADIO</b>		
	<ul style="list-style-type: none"> <li>Check operation of heater blower and radio.</li> </ul>	Heater blower and radio do not work Heater blower and radio do work	GO to 1.5. GO to 1.6.
<b>1.4</b>	<b>CHECK WASHER JET AND HOSE</b>		
	<ul style="list-style-type: none"> <li>Inspect washer jet for blockage.</li> <li>Inspect washer hose for blockage or kinks.</li> </ul>	Blocked jet or blocked or kinked hose 	CLEAN or REPLACE washer jet or washer hose.
<b>1.5</b>	<b>CHECK FOR POWER AT IGNITION SWITCH</b>		
	<ul style="list-style-type: none"> <li>At accessory terminal check for power at ignition switch.</li> </ul>	No power Power OK at switch	REPAIR or REPLACE ignition switch. GO to 2.1.
<b>1.6</b>	<b>CHECK POWER AT WIPER-WASHER SWITCH</b>		
	<ul style="list-style-type: none"> <li>Check for power to wiper-washer switch.</li> </ul>	Power  Power 	REPAIR accessory circuit to wiper-washer switch. GO to 1.7.
<b>1.7</b>	<b>CHECK FOR POWER AT WASHER PUMP</b>		
	<ul style="list-style-type: none"> <li>Using a voltmeter, actuate the washer switch and check for power at washer pump.</li> </ul>	No power at pump Power at pump	GO to 1.8. GO to 1.9.

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## WINDSHIELD WASHER DOES NOT WORK (CONT'D.)

TEST STEP		RESULT	ACTION TO TAKE
1.8	CHECK POWER AT PUMP TERMINAL		
	• Check for power at pump terminal of washer switch.	Power 	REPAIR or REPLACE washer switch.
		Power 	REPAIR circuit in wiring or connector to pump.
1.9	CHECK GROUND		
	• Check ground at pump connector.	Ground 	REPAIR ground.
		Ground 	GO to 2.0.
2.0	CHECK PUMP OUTLET		
	• Inspect washer pump outlet for blockage.	Blocked 	REMOVE and CLEAN washer pump.
			REPLACE pump.
2.1	CHECK FOR POWER AT ACCESSORY RELAY		
	• Check for power to accessory relay, if so equipped, or check wiring to accessories.	No power to relay or wiring damaged 	REPAIR circuit between ignition switch and accessory relay, if so equipped, or repair wiring to accessories.
		Power 	REPLACE accessory relay, if so equipped.

CK6837-2A

## ADJUSTMENTS

## Washer Nozzle

## F-150—F-350, F-Super Duty and Bronco

The washer housing has two adjustable washer nozzles. Insert a small, open safety pin in either nozzle and move the nozzle to the desired spray position.

## E-150—E-350

The washer nozzle on the E-150—E-350 is not adjustable.

## REMOVAL AND INSTALLATION

## Windshield Washer Reservoir And Motor Assembly

To remove the assembly from the vehicle, disconnect the motor electrical connector (use a small screwdriver to unlock tabs) and hose, remove the retaining screws or nuts and lift the assembly from the fender apron (or radiator support or air cleaner bracket) (Fig. 4). Disconnecting the hose will drain the reservoir. The washer reservoir and cover assembly are not serviced separately. The motor retaining ring, seal and pump impeller assembly are serviced separately.

**CAUTION:** Do not make electrical connection prior to filling reservoir. Do not operate reservoir pump prior to filling reservoir.

## Motor, Seal and Impeller Assembly

1. Remove reservoir assembly from vehicle. Disconnect electrical plug and hose.
2. Using a small-bladed screwdriver, pry out retaining ring (Fig. 2).
3. Using pliers to grip one wall around the electrical terminals (Fig. 3), pull out the motor, seal and impeller assembly. If the impeller and seal come off when the motor is pulled, they can be reassembled. Make certain the reservoir pump chamber is free of foreign material prior to installing the old assembly in the new reservoir.
4. Before installing the assembly, lubricate the outside diameter of the seal (Fig. 2) with a dry lubricant such as powdered graphite. This will prevent the seal from sticking to the wall of the reservoir motor cavity and make assembly easier.
5. Align small projection on the motor end cap with the slot in the reservoir (Fig. 2) and assemble so that the seal seats against the bottom of the motor cavity.
6. Using a 25.4mm (1-inch) socket (preferably 12 point), hand press retaining ring securely against motor end plate.
7. Connect electrical plug and hose and replace the reservoir assembly in the vehicle.
8. Fill the reservoir and operate the washer system.

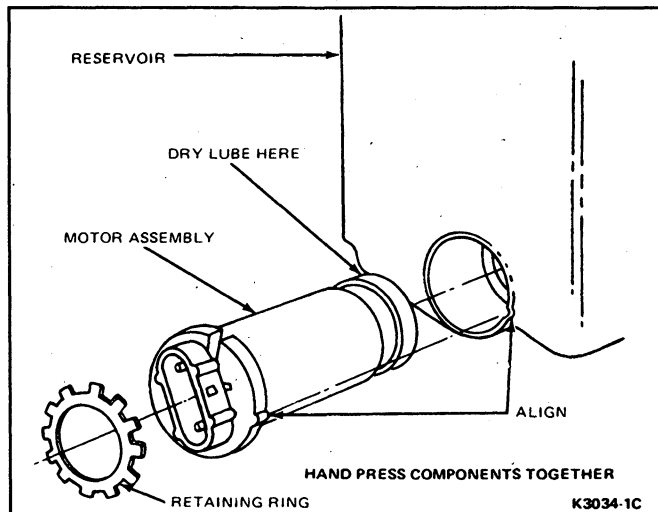


FIG. 2 Windshield Washer Motor Replacement

9. Check for leaks and align the cowl-mounted jets if necessary.

**CAUTION:** Do not operate pump until fluid is added to the reservoir.

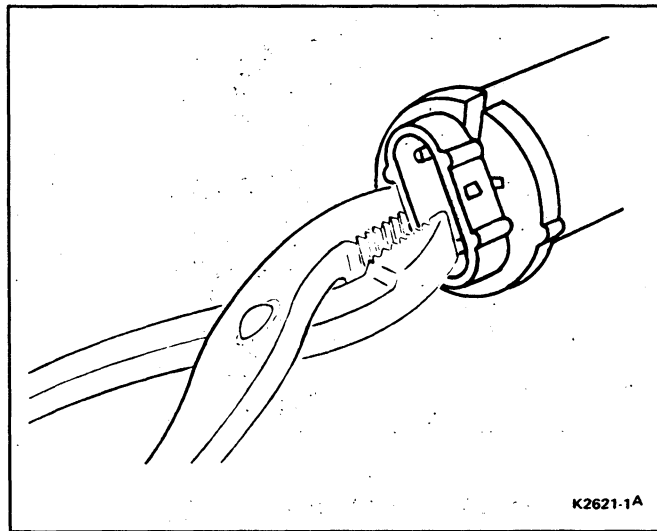


FIG. 3 Disassembling Motor, Seal and Impeller Assembly

## Jets

### F-150—F-350, F-Super Duty and Bronco

#### Removal

1. Disconnect the washer nozzle hose using a long-blade screwdriver (Fig. 4).
2. Squeeze the nozzle housing locking tabs and push the nozzle assembly up through the cowl grille.

#### Installation

Reverse the removal procedure making sure the wiper motor is in PARK and the wiper arm and blade is set to Dimension X, as shown in Section 35-60, Windshield Wipers—Electric.

### E-150—E-350

#### Removal and Installation

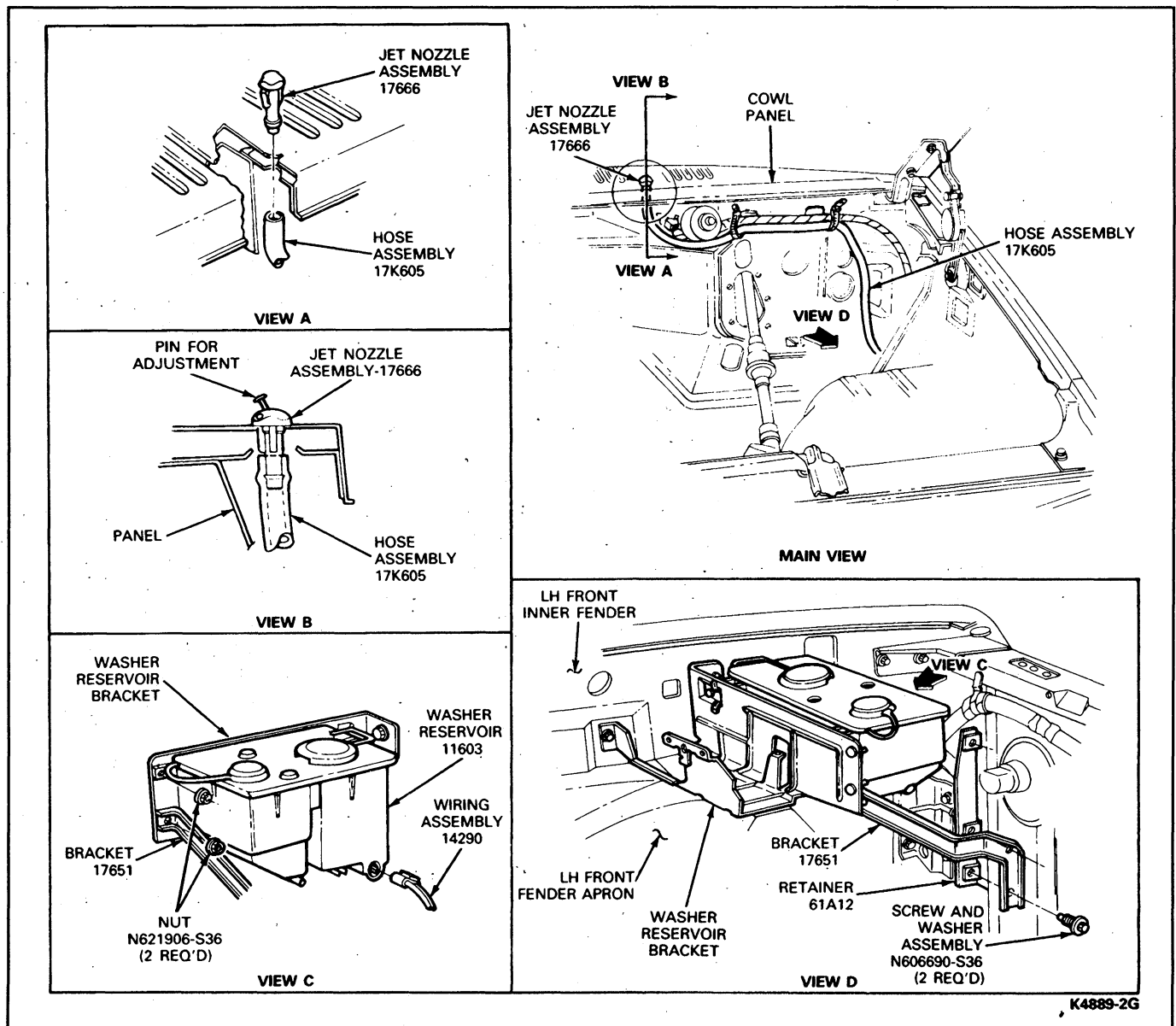
1. Remove the hose from the upper nozzle and remove the upper arm (Figs. 5 and 6).
2. Remove the nozzle from the wiper arm and disconnect the hose.
3. Remove the windshield washer hose shield by prying the two locking tabs out. Remove the metal and rubber hose assembly.
4. Fish the rubber hose behind the two springs, connect and install the metal hose.
5. Hook the end of the windshield washer hose shield under the lip in the head and pivot into position.
6. Then, lock in position by bending the two locking tabs down.
7. Push the hose onto the nozzle fully and install the nozzle to the arm.
8. Install the wiper arm to the shaft and connect the hose. Refer to Section 35-60 Windshield Wipers—Electric.

## SPECIAL SERVICE TOOLS

### ROTUNDA EQUIPMENT

Number	Description
007-00001	Digital Volt-Ohmmeter

CK10195-1A



**FIG. 4 Washer Pump, Reservoir and Jet Installation—F-150—F-350, F-Super Duty and Bronco with Gasoline Engines**

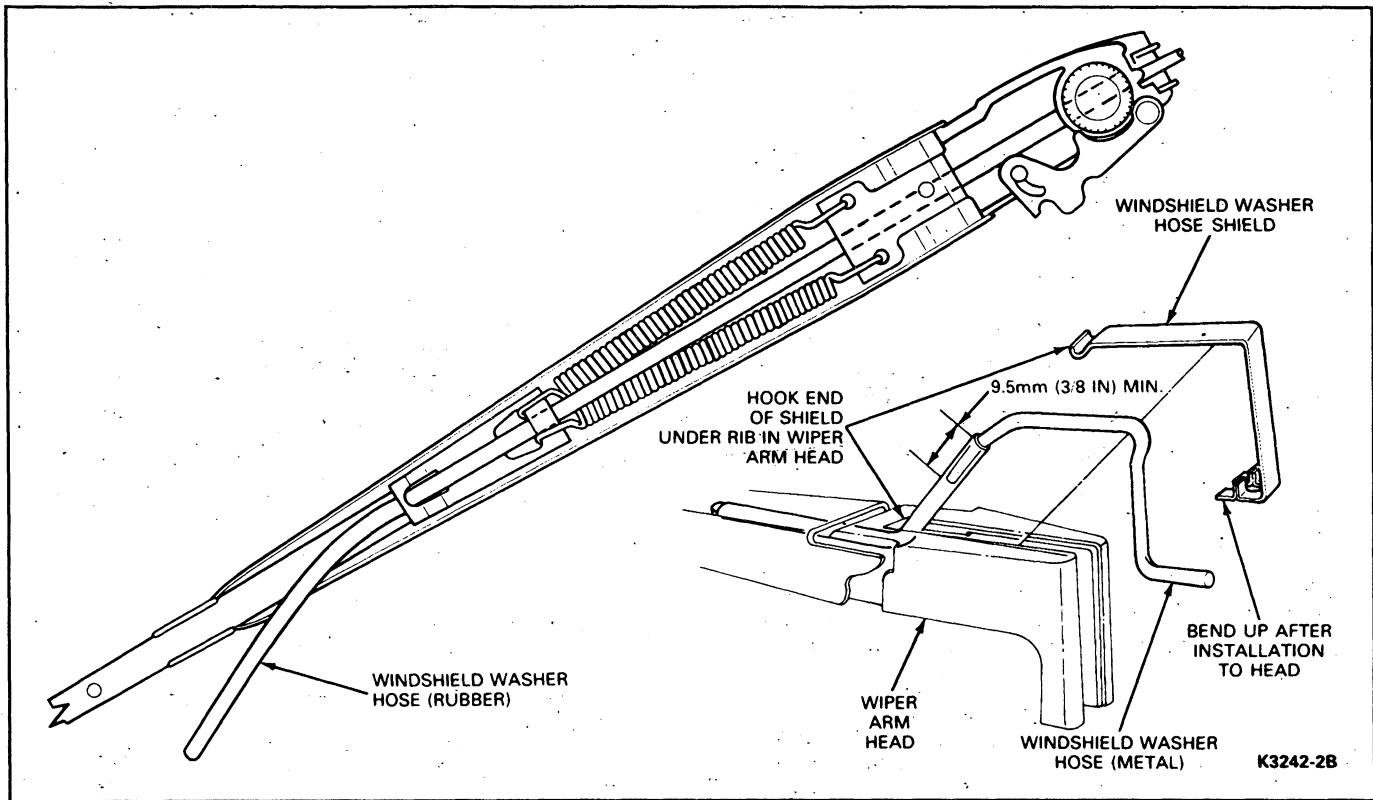


FIG. 5 Windshield Washer Nozzle Installation—E-150—E-350

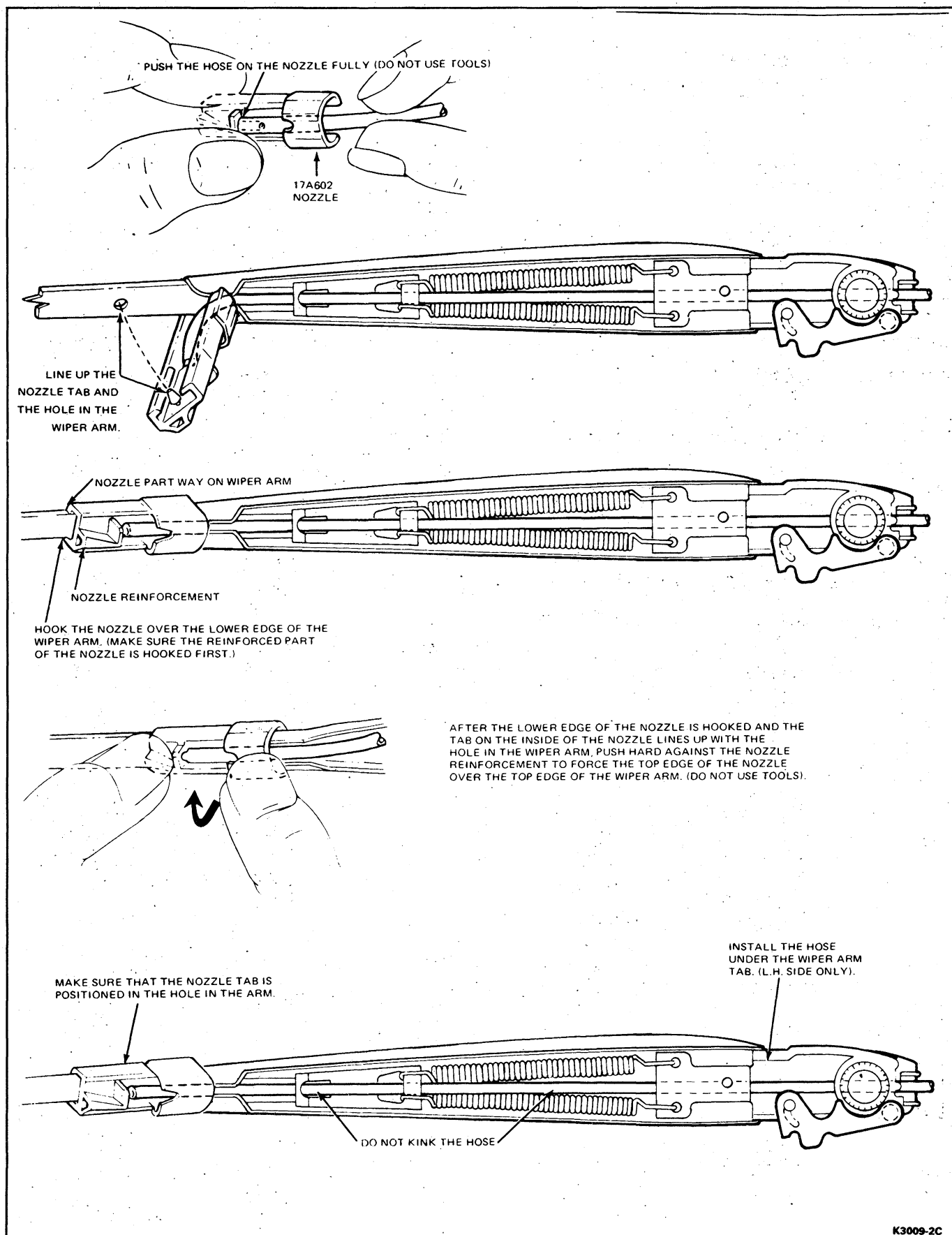


FIG. 6 Windshield Washer Hose Installation—E-150—E-350

# SECTION 35-80 Horns

SUBJECT	PAGE
DESCRIPTION AND OPERATION .....	35-80-1
DIAGNOSIS AND TESTING	
All Vehicle Lines Circuit Check .....	35-80-1
With Testing Equipment .....	35-80-1
Without Test Equipment .....	35-80-1
REMOVAL AND INSTALLATION	
Electric Horns .....	35-80-2
Horn Relay .....	35-80-2

SUBJECT	PAGE
REMOVAL AND INSTALLATION (Cont'd)	
Horn Relay (Cont'd)	
Bronco and F-150—F-350 and F-Super Duty .....	35-80-2
E-150—E-350 .....	35-80-2
Horn Switch .....	35-80-2
SPECIAL SERVICE TOOLS .....	35-80-3
VEHICLE APPLICATION .....	35-80-1

## VEHICLE APPLICATION

All Light Truck Models.

## DESCRIPTION AND OPERATION

Dual horns are standard on the Bronco, F-150 through F-350, F-Super Duty and E-150—E-350. The horn button completes the circuit direct to the horn(s). A horn relay is used on vehicles with speed control.

## DIAGNOSIS AND TESTING

### All Vehicle Lines Circuit Check

#### With Testing Equipment

Verify that the ground connection to the horn is good by checking that the torque on the mounting screw is 17-24 N·m (12-18 ft-lb). Connect a wire from the positive terminal of the battery to the horn. If the horn blows normally, check the horn wiring, if it does not, proceed as follows:

Connect a voltmeter (such as Rotunda Digital Volt Ohm Meter 007-00001 or equivalent) and ammeter to the horn and vehicle battery as shown in Fig. 1. The voltmeter should read battery voltage. If the current reads zero amps, (open circuit), turn the adjusting screw counterclockwise until the meter reads 5.0-5.5 amps. Secure screw by clinching housing extrusions with

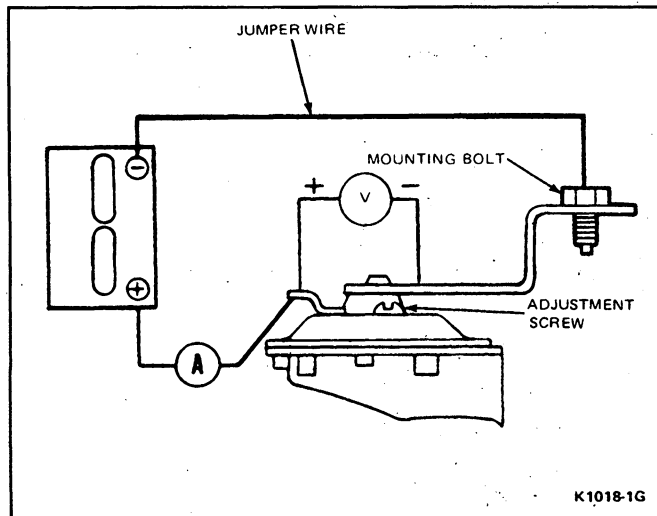


FIG. 1 Horn Current Test—With Test Equipment

diagonals or pliers. If the current is greater than 5.5 amps, turn adjusting screw clockwise until the meter reads 5.5 amps. If the horn cannot be adjusted to 5.0-5.5 amps, replace the horn.

#### Without Test Equipment

Connect a jumper wire from the fastener (bolt) of the horn mounting bracket to the battery ground terminal (Fig. 2). Connect another jumper wire from the horn terminal to the positive (+) terminal of the battery (Fig. 2). If the horn does not sound, and there is no evidence of a spark at the battery terminal, disconnect the jumper wires and turn the adjusting screw counterclockwise 1/4-3/8 turn and secure screw by clinching housing extrusions with diagonals or pliers. If the horn does not sound when the jumper wires are reconnected, replace the horn.

## REMOVAL AND INSTALLATION

### Electric Horns

Econoline horn assemblies are mounted in the engine compartment. The E-150—E-350 standard low pitch horn is mounted on the LH side of the fender apron reinforcement, next to the battery. The high pitch

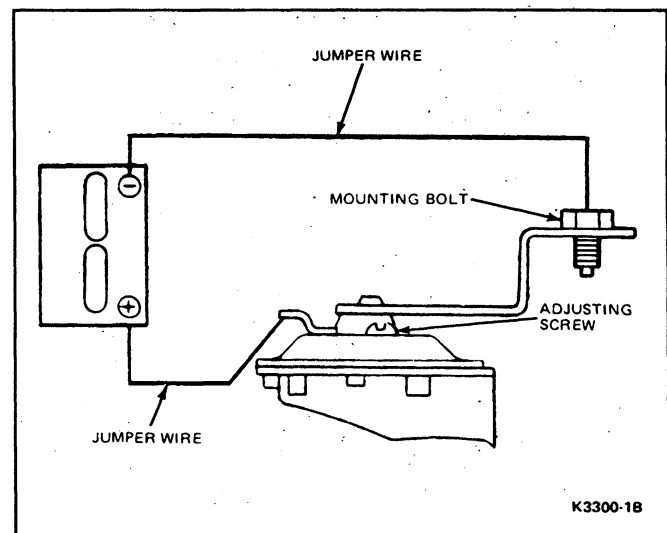


FIG. 2 Horn Current Draw Test—Without Test Equipment

horn is mounted next to the battery, high on the LH radiator support (Fig. 3).

The Bronco, F-150—F-350 and F-Super Duty high and low pitch horns are mounted to the LH radiator support (Fig. 3).

#### Removal

1. Disconnect wire from terminal.
2. Remove mounting bolt and horn.

#### Installation

1. Position horn to bracket.
2. Install mounting bolt. Tighten to 8-12 N·m (6-9 ft·lb).
3. Connect wire to terminal.

#### Horn Switch

##### Removal

1. Remove one screw from the underside of each steering wheel spoke, and lift the horn switch assembly (steering wheel pad) from the steering wheel (Fig. 4).
2. Disconnect the horn switch wires by pulling the spade terminal from the blade connector on speed control vehicles only (Fig. 5). Squeeze or pinch the ground wire terminal firmly and pull it out of the hole in the steering wheel. Do not pull the ground terminal out of the threaded hole without squeezing the terminal to relieve retaining spring tension.

##### Installation

1. To install, connect the spade terminals to the blade connector. Press the ground terminal fully into the threaded hole (speed control only) (Fig. 5).
2. Center the horn switch (pad) on the steering wheel. Install the two attaching screws.

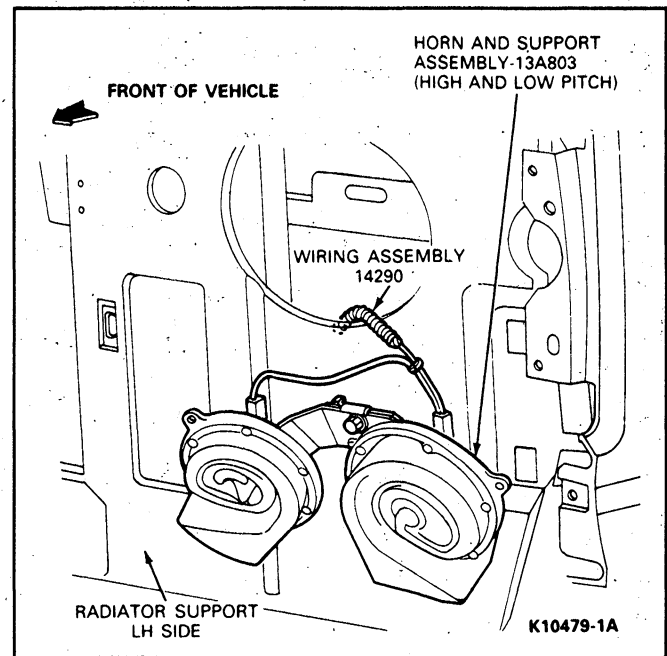
#### Horn Relay

##### Bronco and F-150—F-350 and F-Super Duty

A horn relay used only on vehicles equipped with speed control. It is located under the instrument panel to the left of the steering column. The relay is mounted on the outboard attaching screw of the speed control amplifier module.

##### Removal

1. Remove electrical connector from relay.



**FIG. 3 Horn Installation—F-150—F-350, F-Super Duty and Bronco**

2. Remove retaining screws and relay.

##### Installation

1. Position relay and install retaining screws.
2. Connect electrical connector to relay. Test operation of horn(s).

##### E-150—E-350

The E-150—E-350 horn relay is only used on speed control vehicles. It is located under the instrument panel to the left of the steering column on the fuse panel mounting bracket.

##### Removal

1. Remove electrical connector from relay.
2. Remove retaining screw and relay.

##### Installation

1. Position relay and install retaining screw.
2. Connect electrical connector to relay. Test operation of horns.

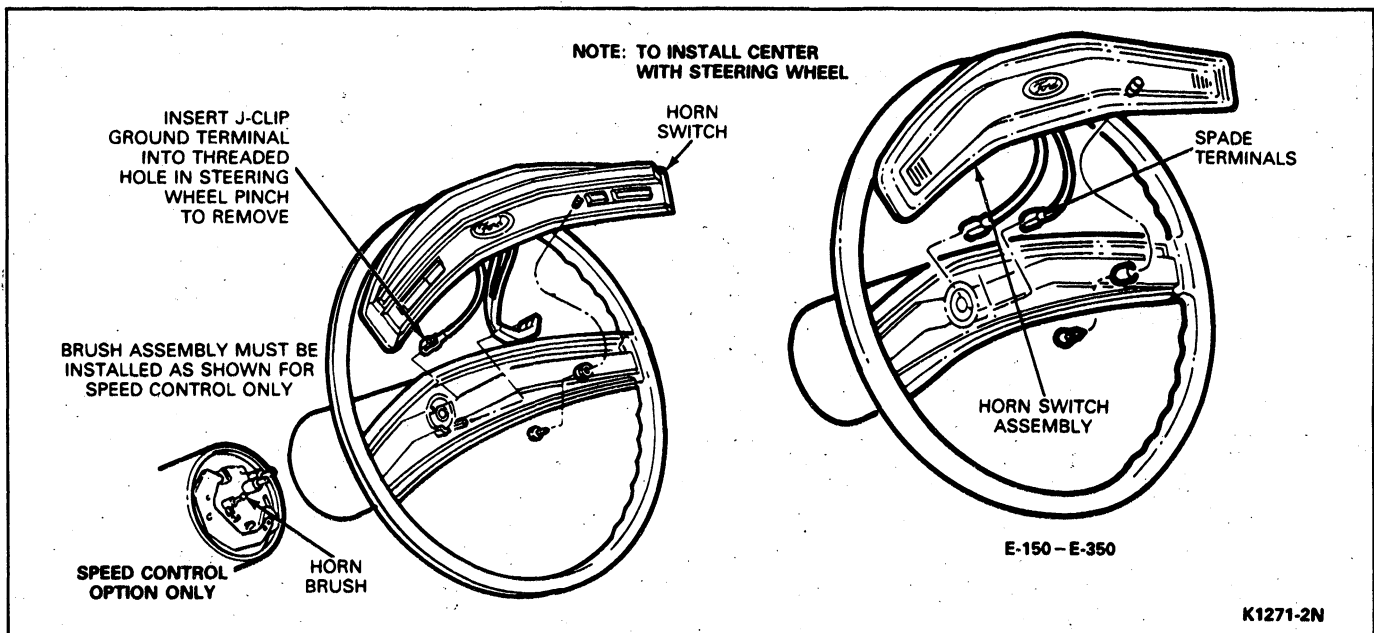


FIG. 4 Horn Contact Button E-150—E-350

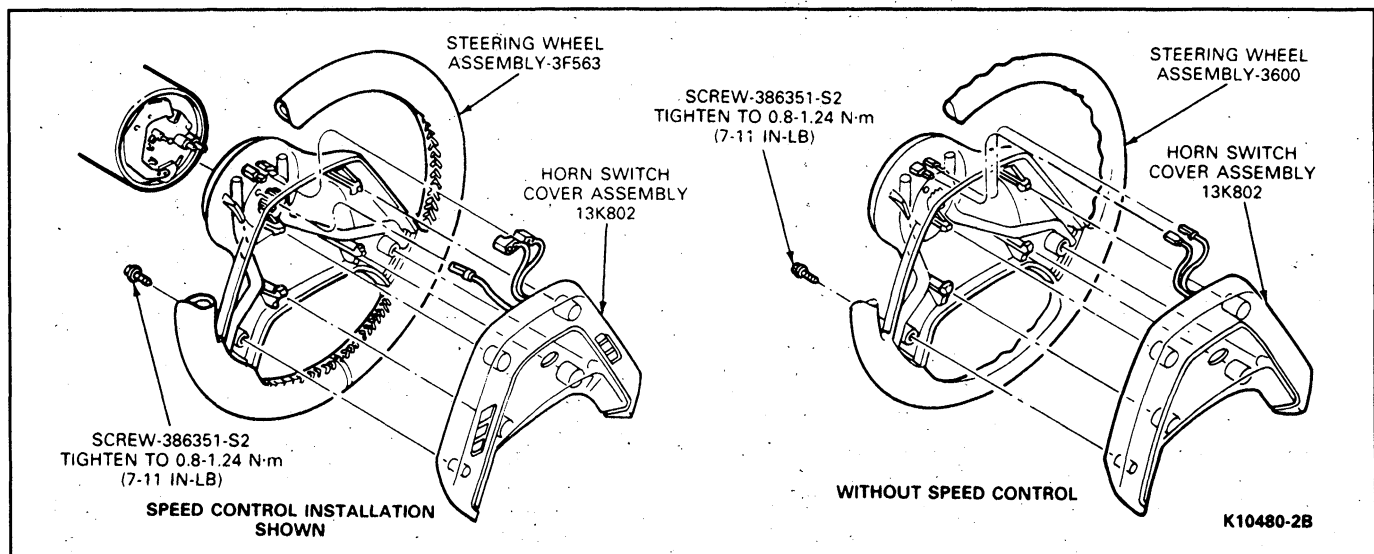


FIG. 5 Horn Switch Cover Assembly F-150—F-350, F-Super Duty and Bronco

## SPECIAL SERVICE TOOLS

## ROTUNDA EQUIPMENT

Model	Description
007-00001	Digital Volt Ohmmeter

CK9061-1B



# SECTION 36-10 Heating System General Service

SUBJECT	PAGE	SUBJECT	PAGE
<b>DESCRIPTION AND OPERATION</b>		<b>DIAGNOSIS AND TESTING (Cont'd)</b>	
Blower Switch .....	36-10-1	Diagnosis Guides .....	36-10-3
Heating Systems and Control Doors .....	36-10-1	Heater Core Leak Test .....	36-10-2
Safety Precautions .....	36-10-1	Heater Core Back-Flushing .....	36-10-2
<b>DIAGNOSIS AND TESTING</b>		Loose Blower Wheel Test .....	36-10-1
Bleeding Air From Heater Core .....	36-10-2	Open Circuit Test .....	36-10-2
Blower Motor Current Draw Test .....	36-10-1	Visual Check—Blower .....	36-10-1
Blower Motor Voltage Test .....	36-10-1	<b>SPECIAL SERVICE TOOLS</b> .....	36-10-5
Blower Switch Continuity Test .....	36-10-1	<b>VEHICLE APPLICATION</b> .....	36-10-1

## VEHICLE APPLICATION

E150—E350, F150—F350, F-Super Duty and Bronco.

## DESCRIPTION AND OPERATION

### Heating Systems and Control Doors

All heater plenum assemblies contain a heater core, through which coolant flows from the engine, and a blower. The air (forced by blower or ram effect) passes through and/or around the heater core and discharges through various outlets.

Several doors determine the amount of air passing through the heater core and the particular outlet(s) through which it discharges. The number of doors used and the manner in which they are actuated differ according to the particular system function. Two control levers (function and temperature) determine location of discharge air and temperature.

### Blower Switch

Battery voltage is delivered directly to the blower motor whenever the ignition switch is on. Blower motor speed is controlled by the blower motor resistor through three separate circuits. Various positions of the blower motor switch energize these circuits.

When the blower switch is moved to the blower speed selected, a circuit is completed to ground. Current flow from the battery to the blower motor, blower motor resistor, and blower motor switch operates the blower motor. The different blower motor speeds result from the amount of resistance in each of the circuits. Greater circuit resistance results in slower motor speed.

When the blower switch is moved to the HIGH speed position, a separate circuit is completed. The high speed circuit is completed directly from the blower motor, through the blower switch to ground. This circuit allows full battery voltage, producing maximum blower motor speed.

### Safety Precautions

Whenever components in the engine compartment or instrument panel areas are being serviced, the battery ground cable must be disconnected to eliminate the possibility of electrical shorts, burned-up wiring, and fires. Extreme care must be exercised when performing

electrical tests where the battery must be connected to operate the system.

Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with the vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gasses outside the closed area.

## DIAGNOSIS AND TESTING

Various tests checking heater system operations are included below. In addition to these tests, visual inspection of all heater system components and connections, including inspections for air leaks in the body should be made to ensure proper operation.

### Visual Check—Blower

Check to see that all blower motor connections are correct including proper ground of the system. Check the resistor connection at heater case and the heater fuse. Also check the connection at the rear of the blower switch located on the control assembly.

### Loose Blower Wheel Test

Place the blower switch in HIGH position. If airflow is not evident but the motor can be heard, the blower wheel may not be secured to the motor shaft. Do not replace the blower motor unless the unit fails the current draw test.

### Blower Motor Current Draw Test

#### Heater System

Refer to Section 36-25, Heater System.

### Blower Motor Voltage Test

#### Heater System

Refer to Section 36-25, Heater System.

### Blower Switch Continuity Test

Refer to appropriate electrical schematic (Fig. 1). Check for continuity between connected terminals with a self-powered test lamp or an ohmmeter as shown on the schematic. Check terminal continuity at every lever position. The lamp should go on for each connected pair of terminals.

If the ohmmeter moves or the test lamp lights, the circuit is closed. If the ohmmeter moves only slightly,

the circuit may have high resistance due to a loose connection.

### Open Circuit Test

On all electrical circuits, continuity must exist from the source of power (battery), to the unit where the power is used, and back up to the source of power (ground).

An ohmmeter or self-powered test lamp, connected between any two points of a circuit will show whether the circuit is open or continuous.

If the meter does not move or the lamp does not light, the circuit is open.

If the meter movement is slight, high resistance is indicated.

### Bleeding Air From Heater Core

Remove the hose at the outlet connection of the heater core (hose leading to the water pump). Allow any trapped air to flow out. When a continuous flow of coolant is obtained, connect the hose to the core. Do not overtighten heater hose clamps.

### Heater Core Leak Test

#### Inspection

1. Inspect for visible evidence of coolant leakage at the hose to heater core attachments. A coolant leak at the hose could follow the heater core tube to the core and appear as a leak in the heater core.
2. Check the system for loose heater hose clamps. The clamps should be tightened to 1.81-2.49 N·m (16-22 in-lbs).
3. If leakage is found and the hose clamps are tight, check the heater core tubes for distortion. Severe distortion of the tubes could cause leakage at the hose connection.

#### Pressure Test

1. Drain the cooling system.
2. Disconnect the heater hoses from the heater core tubes.
3. Install a short piece of heater hose (approximately 100mm or 4 inches long) onto each heater core tube (Fig. 2).

4. Fill the heater core and hoses with water and install Plug (BT-7422-B) and Adapter (BT-7422-A) Fig. 3 from Radiator Pressure Tester 021-00012 or equivalent in the hose ends (Fig. 2). Secure the hoses to the heater core, plug and adapter with hose clamps.
5. Attach Radiator Pressure Tester 021-00012 or equivalent to the adapter (Fig. 4). Close the bleed valve at the base of the gauge and pump 207 kPa (30 psi) of air pressure into the heater core.
6. Observe the pressure gauge for a minimum of three minutes. The pressure should not drop.
7. If the pressure does not drop, no leaks are indicated.
8. If the pressure drops, check the hose connections at the core tubes for leaks. If the hoses do not leak, remove the heater core from the vehicle and test the core as outlined under Bench Test.

### Bench Test

1. Drain all coolant from the heater core.
2. Connect the 100mm (four inch) test hoses with plug and adapter to the core tubes. Then, connect Radiator Pressure Tester 021-00012 or equivalent to the adapter (Fig. 5).
3. Apply 207 kPa (30 psi) of air pressure to the heater core with Radiator Pressure Tester 021-00012 or equivalent, and submerge the core in water.
4. If a leak is observed, repair or replace the heater core as necessary.

### Heater Core Back-Flushing

All engine cooling system flushing and back-flushing must include a separate back-flushing of the heater or A/C system heater core. Separate flushing or back-flushing of the engine cooling system and heater core prevent engine cooling system particles from clogging the heater core tubes and reducing (or eliminating) coolant flow through the heater core.

The heater core must be back-flushed separately from the engine cooling system for proper back-flush water flow direction through the heater core.

The correct heater core back-flushing procedure is as follows:

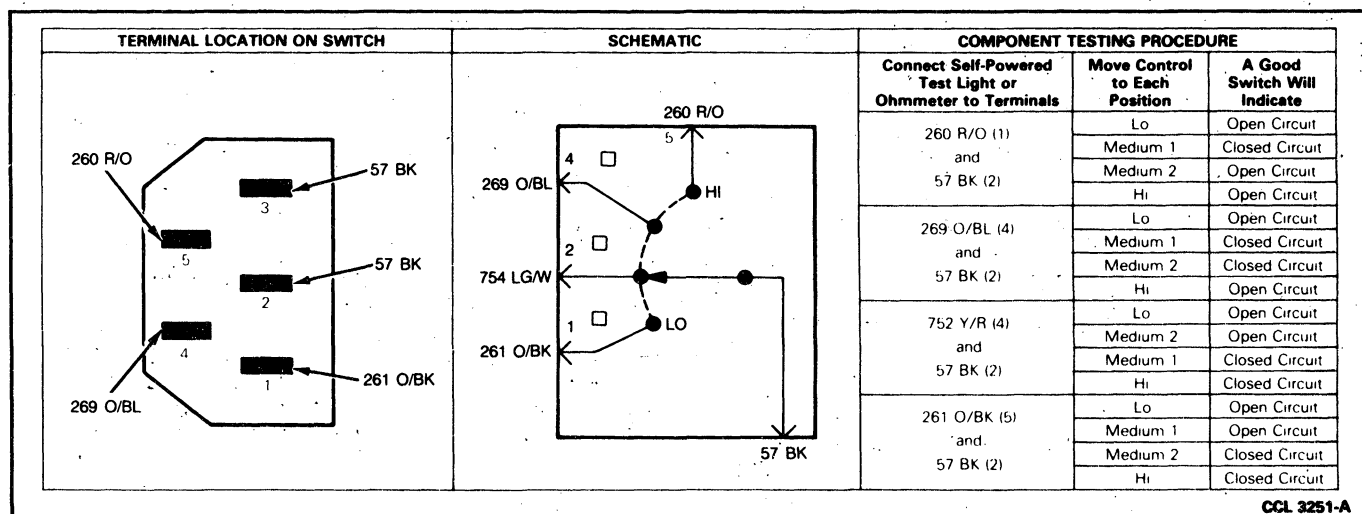


FIG. 1 Blower Switch Continuity Test

## Diagnosis Guides

CONDITION	POSSIBLE CAUSE	RESOLUTION
Insufficient, erratic, or no heat or defrost.	Low radiator coolant level due to: Coolant leaks.	Check radiator cap pressure. Replace if below minimum pressure. Fill to specified coolant level. Pressure test for engine cooling system and heater system leaks. Service as required.
	Engine overheating.	Remove bugs, leaves, etc. from radiator or condenser fins. Check for: Loose fan belt Sticking thermostat Incorrect ignition timing Water pump impeller damage Restricted cooling system Service as required.
	Loose fan belt.	Replace if cracked or worn and/or adjust belt tension.
	Thermostat.	Check coolant temperature at radiator filler neck. If under 170°F, replace thermostat. See Group 27 for complete testing.
	Plugged or partially plugged heater core.	Clean and backflush engine cooling system and heater core.
	Loose or improperly adjusted control cables.	Adjust to specifications.
	Kinked, clogged, collapsed, soft, swollen, or decomposed engine cooling system or heater system hoses.	Replace damaged hoses and backflush engine cooling system, then heater system, until all particles have been removed.
	Blocked air inlet.	Check cowl air inlet for leaves, foreign material, etc. Remove as required. Check internal blower inlet screen (on vehicles so equipped) for leaves and foreign material.

CK5870-2B

1. Disconnect the heater core outlet heater hose from the water pump fitting and install a female garden hose-end fitting adapter into the end of the outlet heater hose. Secure with a hose clamp.
2. Connect the female garden hose-end of the outlet heater hose to the male end of a water supply garden hose.
3. Disconnect the heater core inlet heater hose from the engine block fitting. Allow inlet hose to drain onto the ground or into a floor drain.
4. Turn the water supply valve on and off several times so that the surge action will help to dislodge larger stubborn particles from the heater core tubes. Allow full water pressure to flow for approximately five minutes.
5. Remove the hose clamp and female garden hose-end adapter from the end of the outlet heater hose. Install the outlet heater hose onto the water pump fitting. Secure with hose clamp.
6. Connect the inlet heater hose onto the engine block fitting. Secure with hose clamp.
7. Fill the cooling system, as described in Section 27-02, Cooling System Service, with the specified coolant mixture of 50/50 Premium Cooling System Fluid E2FZ-19549-AA (ESE-M97B44-A) and water or equivalent.
8. Test the system for proper heater performance under the specified engine cooling system conditions.

CONDITION	POSSIBLE CAUSE	RESOLUTION
Blower does not operate properly. Check fuse.	Blower motor.	Connect a #10 gauge (or larger diameter) jumper wire directly from the positive battery terminal to the positive lead (orange wire) of the blower motor. If the motor runs, the problem must be external to the motor. If the motor will not run, connect a #10 gauge (or larger diameter) jumper wire from the motor black lead to a good ground. If the motor runs, the trouble is in the ground circuit. On vehicles with ground side switching, check the blower resistor, the blower switch and the harness connections. Service as required. If motor still will not run, the motor is inoperative and should be replaced.
	Blower resistor.	Check continuity of resistors for opens or shorts (self-powered test lamp). Service or replace as required.
	Blower wire harness.	Check for proper installation of harness connector terminal connectors.  Check wire-to-terminal continuity.  Check continuity of wires in harness for shorts, opens, abrasion, etc. Service as required.
	Blower switch(es).	Check blower switch(es) for proper contact. Replace switch(es) as required.
Vacuum motor system	Vacuum leak. Loose or disconnected vacuum hose. Damaged vacuum motor. Misrouted vacuum connections	Repair or repair system components, as required.

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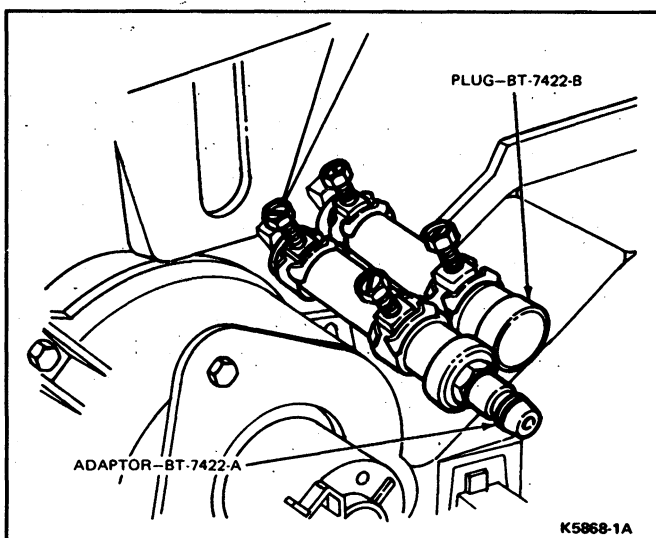


FIG. 2 Heater Hose with Plug and Adapter Installed

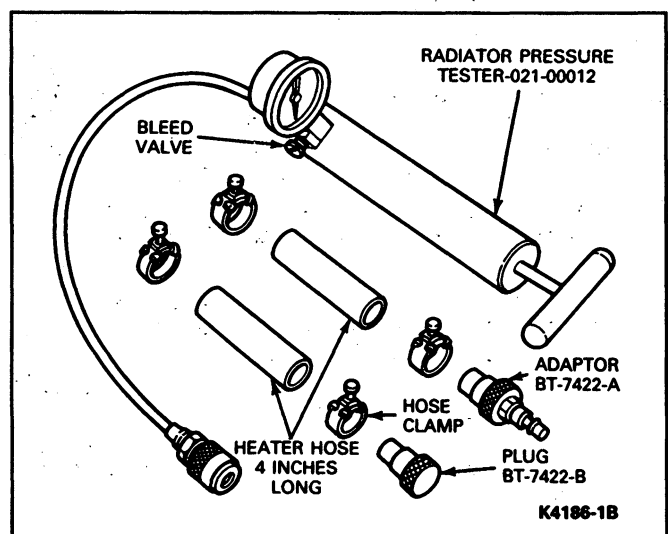
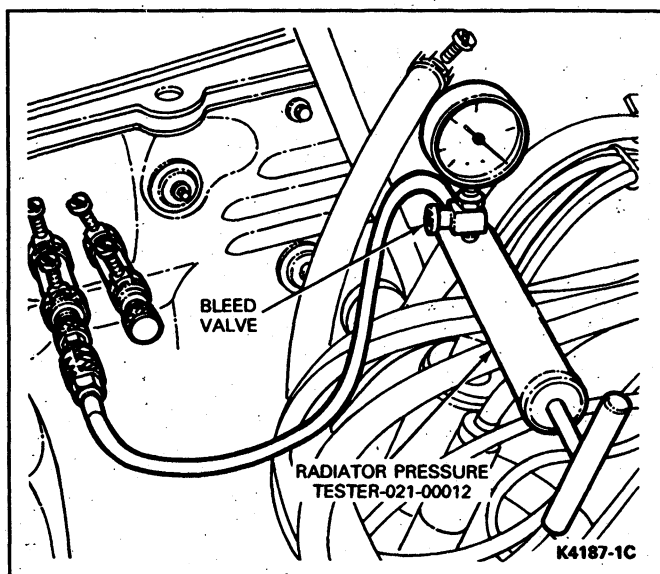
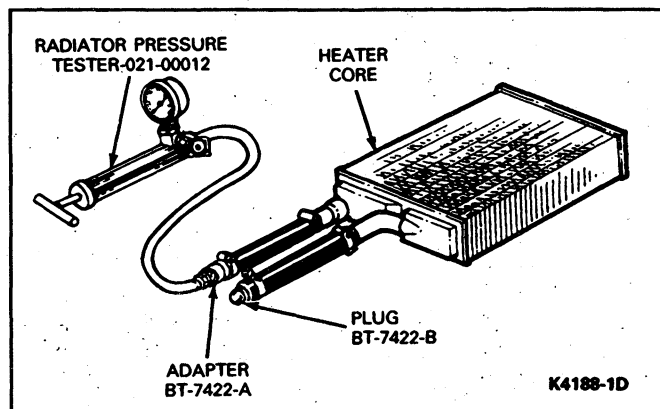


FIG. 3 Radiator Pressure Tester 021-00012 with Heater Hoses and Clamps



**FIG. 4 Radiator Pressure Tester 021-00012 Installed for Pressure Test**



**FIG. 5 Heater Core Bench Test**

## SPECIAL SERVICE TOOLS

### ROTUNDA EQUIPMENT

Part Number	Description
021-00012	Radiator Pressure Tester
BT-7422-A	Adapter
BT-7422-B	Plug

CK5589-1D

# SECTION 36-23 Hi-Output Heating System

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Temperature Control Cable .....	36-23-2	Defroster Nozzle .....	36-23-9
<b>DESCRIPTION</b>		Heater Blower Assembly .....	36-23-11
Heater and Ventilation System .....	36-23-1	Heater Core .....	36-23-5
<b>DIAGNOSIS AND TESTING</b>		Heater Ducts .....	36-23-7
Blower Motor Current Draw Test .....	36-23-3	Heater Hose Installation .....	36-23-12
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<b>MAJOR COMPONENTS</b>		Outside-Recirculating Air Door Vacuum	
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Control Assembly .....	36-23-3		

## VEHICLE APPLICATION

E-150 through E-350 Models.

## DESCRIPTION

### Heater and Ventilation System

The heater is a blend air type which receives its outside air supply from the cowl inlet. The heater control assembly is located in the instrument panel to the right of the steering column. It includes a blower switch which provides four operating speeds. The control assembly also includes two levers. One is provided to allow temperature selection between the extremes of COOL and WARM; the other provides for functional selection between OFF, VENT, HEAT, MIX, and DEFROST. Refer to Figure 1.

Ventilation is delivered through the instrument panel registers when the function lever in the control assembly is set in the VENT position. (Fig. 1.) In the VENT position, the outside/recirc door is open to the outside with no vacuum being applied to the door vacuum motor. The air coming in through the cowl is discharged through the panel registers. A small amount of this input is diverted to the floor area. (The A/C compressor will not be operating when the control lever is in the VENT position.)

In the FLOOR position, the outside/recirc. door is open to the outside airflow with no vacuum being applied to the door's motor. Air is discharged through the floor outlets with a small amount going to the defroster nozzles.

In the MIX position, outside air is discharged through the defroster nozzles and the floor outlets.

In the DEFROST position, outside air is discharged through the defrosters with a small amount going to the floor outlets.

In the OFF position, all doors are in the vacuum-applied position with the exception of the PANEL/DEFROST door.

When the temperature control lever in the control assembly is moved between the COOL and WARM positions, a temperature control cable moves the temperature blend door, which directs a portion of the total air input through the heater core. As the percentage of air exposed to the core increases, the air temperature at the outlets to the passenger compartment also increases. Figure 2 illustrates airflow through the system.

## MAJOR COMPONENTS

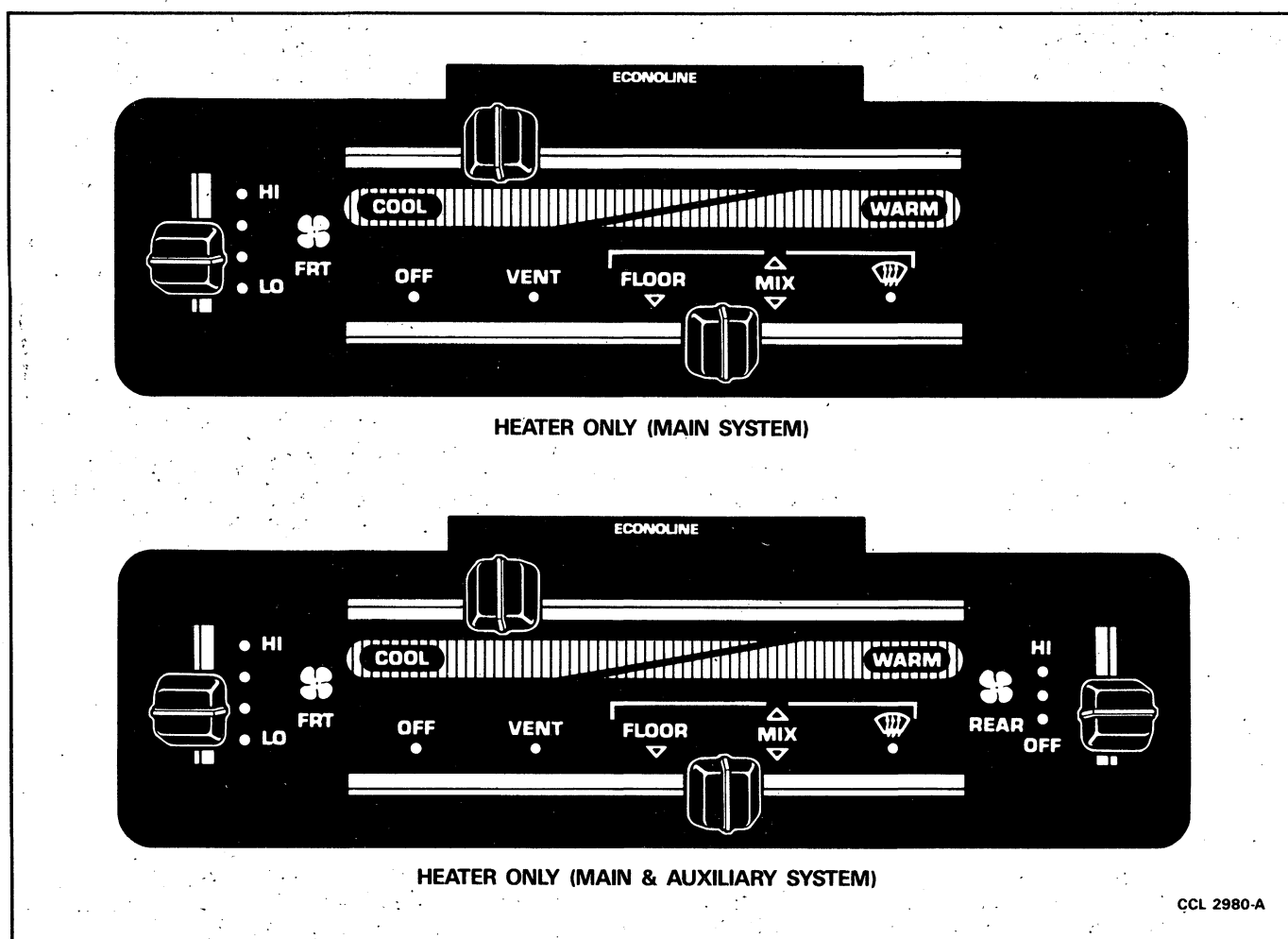
### Control Assembly

Refer to Fig. 3

When the function selector lever is moved to any of its five positions, the appropriate ports in an eight-port vacuum selector valve are actuated. This valve controls the distribution of vacuum to the motors which operate the following doors:

- Outside/Recirc
- Floor/Defrost
- Panel/Defrost

The function selector lever also controls blower operation. When the lever is in the OFF position, the 4-speed blower switch will not operate.



**FIG. 1 Typical Heater-Ventilation Control Assembly**

### Temperature Selector Lever

The temperature selector lever actuates a control cable which operates the temperature blend door. The blower motor will operate at low, medium low, medium high, or high speed, depending upon selection. The function selector lever must be in the OFF position if no blower operation is desired.

### Blower Motor Resistor

A resistor with a thermal limiter is mounted in the scroll area of the evaporator (heater) case. It is used in conjunction with the blower motor switch to obtain the desired fan speed. The thermal limiter in the switch assembly serves as a temperature sensitive fuse.

### Auxiliary Heater System

Refer to Section 36-70 Side-Mounted Auxiliary A/C and/or Heater Systems for all service procedures.

## ADJUSTMENTS

### Temperature Control Cable

1. Set temperature selector lever in COOL position.
2. Remove cable from retaining clip on top of evaporator (heater) case. Do not disconnect cable from yellow crank.
3. Rotate yellow crank counterclockwise until temperature blend door seats.

4. Check to be sure the temperature selector lever is in COOL position. Then, install cable housing into its retaining clip by pushing it from the top until it snaps in place.
5. Set blower switch on HIGH. Move temperature lever through its range to verify that cable adjustment is satisfactory. Repeat Steps 1 through 4 if further adjustment is needed.

## DIAGNOSIS AND TESTING

### Blower Motor Voltage Test

Refer to Figure 4.

The heater system blower motor electrical circuit uses ground side switching. When performing blower motor voltage tests on systems with ground side switching, the voltage reading must be taken across the motor wires.

### Test Procedure

1. Place the temperature selector lever in WARM position.
2. Place function selector lever in the FLOOR position.
3. Insert probes of a voltmeter into wire holes of the motors two hardshell connectors and make contact with wire terminals. Measure voltage drop across motor.

4. With engine running (battery voltage approximately 14.2 volts), the voltage reading should be within the specified range for each blower switch position. Refer to blower switch chart of the electrical wiring diagram for specifications.

### Blower Motor Current Draw Test

1. Separate blower motor ground (black) wire at blower motor resistor.
2. Connect positive (+) ammeter lead to female spade connector and negative (-) ammeter lead to resistor terminal.
3. Place temperature selector lever in mid-position and the function selector lever in the HEAT position to turn blower on.
4. Turn ignition switch to ON position.
5. With a fully charged battery, blower motor current draw (amps) should be approximately as indicated for each blower speed in blower switch chart of the electrical wiring diagram (Fig. 4).

### Vacuum System Tests

To test the A/C-heater control system, start the engine and move the function selector lever slowly from one position to another. A momentary hiss should be heard as the function selector lever is moved from one position to another indicating that vacuum is available at the control assembly. A continuous hiss at the control assembly indicates a major leak somewhere in the system. It does not necessarily indicate that the leak is at the control assembly.

If a momentary hiss cannot be heard when the function selector lever is moved from one position to another, check for a kinked, pinched, or disconnected vacuum supply hose (Fig. 2). Also inspect the check

valve between the intake manifold and the vacuum reservoir to be sure it is working properly.

If a momentary hiss can be heard when the function selector lever is moved from one position to another, vacuum is available at the control assembly. Then, cycle the function selector through each position with the blower on HI and check the location(s) from which air is being discharged.

The airflow schematic in Fig. 5 indicates whether vacuum or no vacuum is being applied and shows the physical position of a door in response to the existing vacuum conditions. The vacuum diagram in Fig. 5 traces the vacuum lines from the selector switch to the motor each operates. If a vacuum motor fails to operate, the faulty one can be identified easily because airflow will not follow its intended course.

If a vacuum motor is inoperative, check its operation with Rotunda Vacuum Tester 021-00014 or equivalent. If the vacuum motor operates properly, the vacuum hose is probably pinched, kinked, disconnected or has a hole (Fig. 5).

## REMOVAL AND INSTALLATION

### Control Assembly

#### Removal

1. Remove trim applique.
2. Remove four screws retaining control assembly to mounting bracket. Refer to Figure 3.
3. Carefully pull control assembly from opening in the mounting bracket.
4. Disconnect electrical connectors from blower switch(s), vacuum selector, and illumination bulb.
5. Remove push-on vacuum harness retaining clips from vacuum selector.
6. Disconnect vacuum harness from vacuum selector.
7. Remove temperature control cable from control assembly. Disconnect bullet-type cable retainer from bracket using Control Cable Removal Tool T83P-18532-AH or equivalent (Fig. 6), or needlenose pliers to compress retaining ears. The cable "S" bend is removed from bottom side of the lever by rotating the cable wire 90 degrees to the lever.

#### Installation

1. Connect temperature control cable to control assembly (Fig. 6).
2. Connect vacuum harness to vacuum selector and retain with two push-on clips.
3. Connect electrical connectors to blower switch(s), vacuum selector valve and illumination bulb wire and socket assembly.
4. Carefully position control assembly to mounting bracket and install four retaining screws.
5. Install applique.
6. Adjust the control cable as outlined under Adjustments, Temperature Control Cable.

### Blower Switch

#### Removal

1. Remove knob from blower switch.

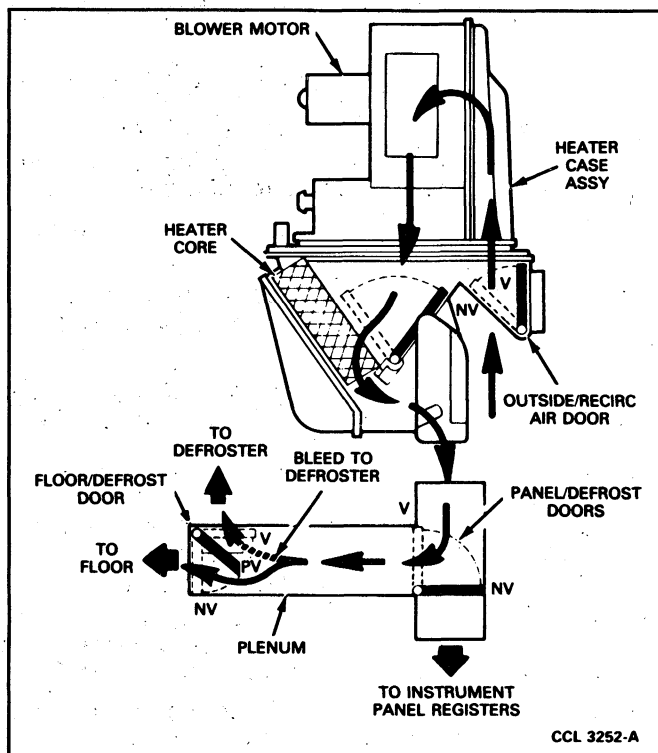
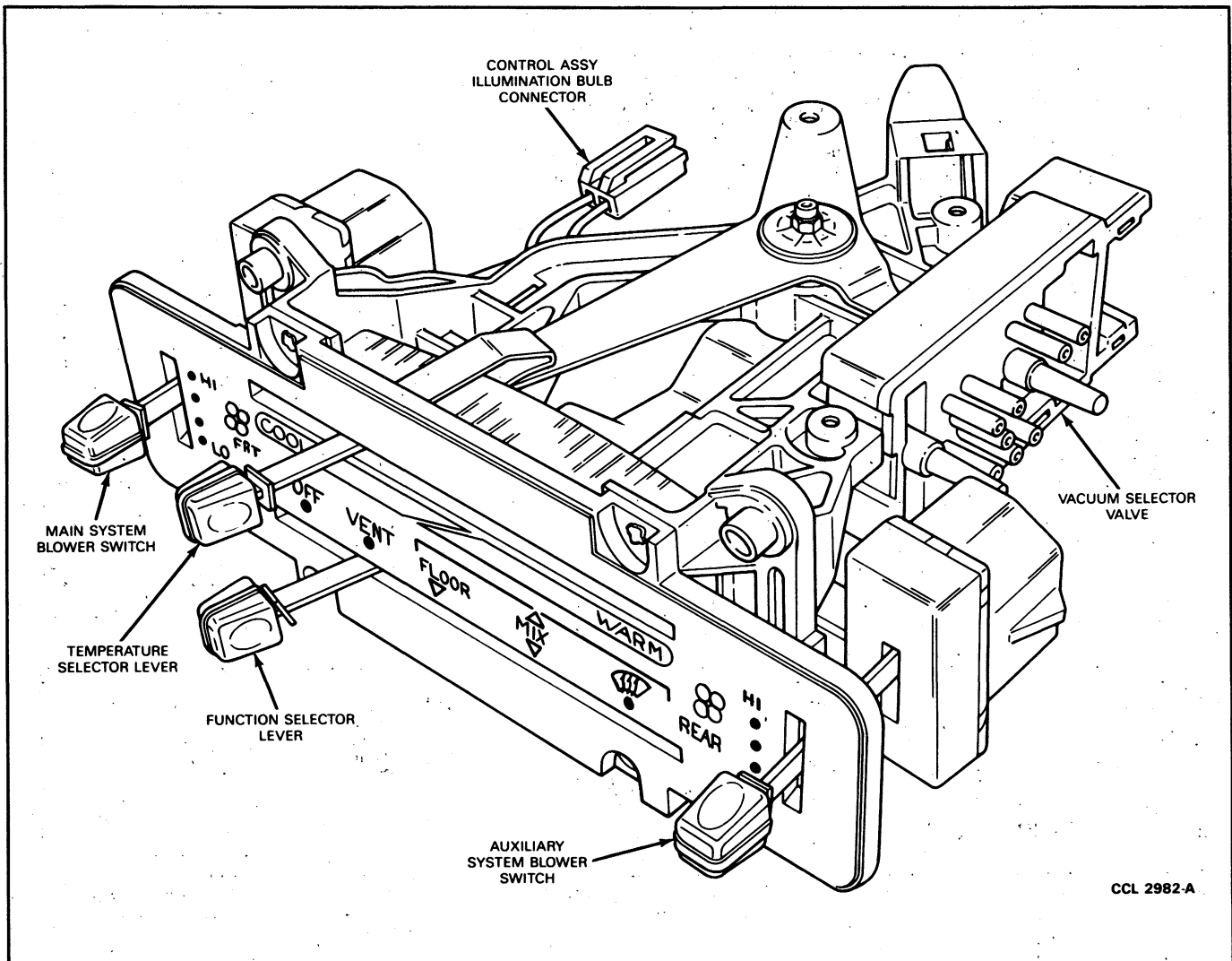


FIG. 2 Heater System Airflow





**FIG. 3 Control Assembly**

2. Remove trim applique.
3. Remove four screws retaining control assembly mounting bracket to instrument panel.
4. Carefully remove control mounting bracket and control assembly from instrument panel opening.
5. To remove blower switch, disconnect wiring connector from blower switch and remove one screw retaining switch mounting bracket to control assembly.

#### Installation

1. Position blower switch and bracket on the control assembly and install one retaining screw.
2. Connect wiring connector to blower switch.
3. Position control assembly and bracket in instrument panel and install four retaining screws (Fig. 3).
4. Install trim applique.
5. Install knob on switch.

#### Vacuum Selector Valve

##### Removal

1. Remove instrument panel trim panel.

2. Remove four screws retaining control assembly mounting bracket to instrument panel.
3. Carefully remove control mounting bracket and control assembly from instrument panel opening.
4. Disconnect wiring connector from vacuum selector valve.
5. Remove two push-on vacuum harness retainer clips from vacuum selector and disconnect harness from valve.
6. Remove two screws retaining vacuum selector valve to control assembly. Remove vacuum selector valve (Fig. 7).

##### Installation

1. Position temperature lever at LH side of slot and the function control lever approximately 9.5mm (3/8 inch) from LH side of slot.
2. Position vacuum selector valve onto control assembly, engaging selector lever arms with selector valve. Install two retaining screws.
3. Connect vacuum harness to selector valve and retain with two pushnuts.
4. Connect wiring connector to selector.

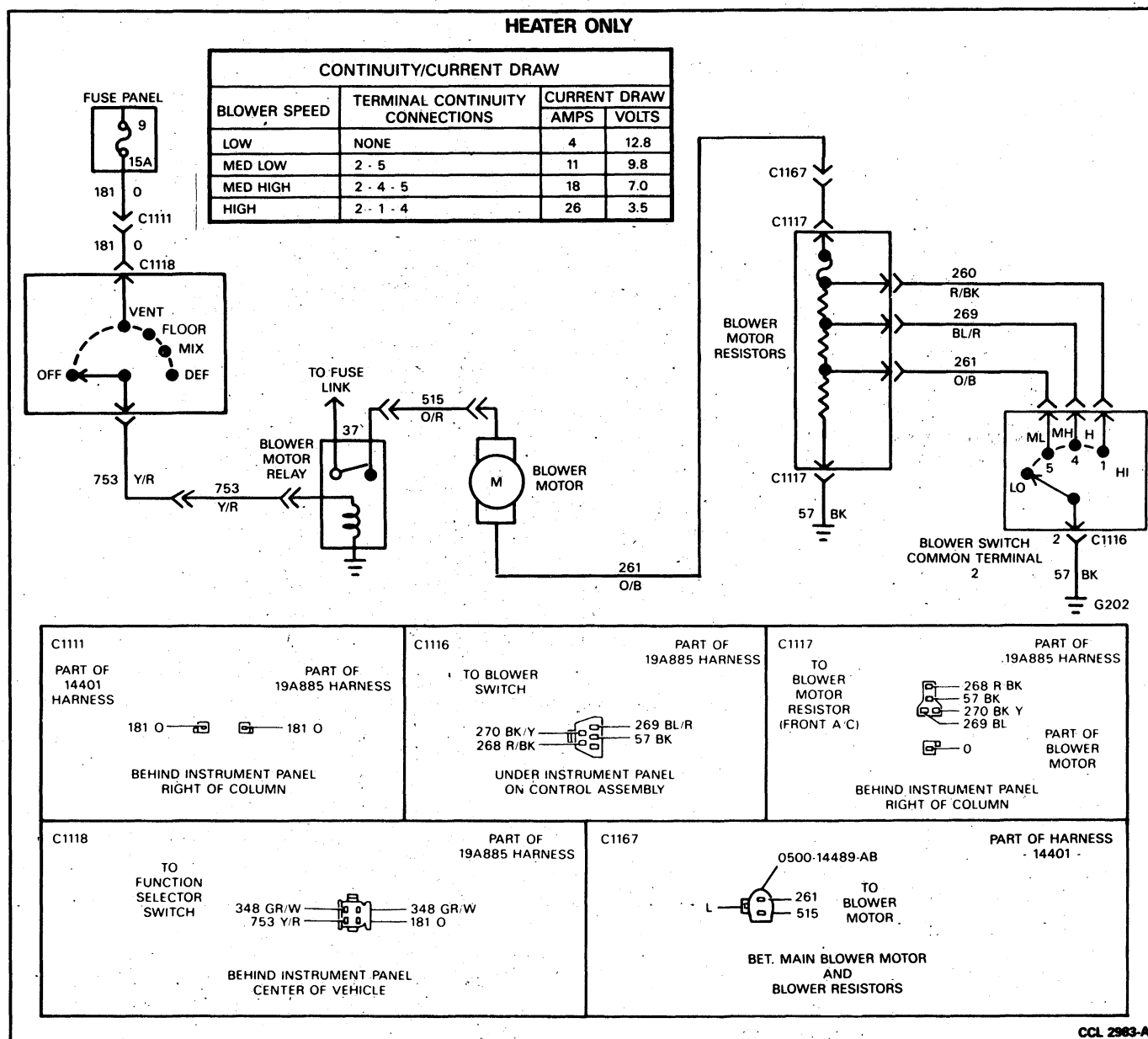


FIG. 4 Heater Electrical Wiring Diagram

- Position control assembly and bracket in instrument panel. Install four retaining screws.
- Install trim panel.

### Heater Core

#### Removal

- Remove inlet and outlet hoses from heater core in the engine compartment. Plug hoses with a suitable 15.87mm (5/8-inch) plug.
- Remove two screws retaining modesty panel to underside of instrument panel.
- Remove modesty panel.
- Remove four screws from heater core cover located on the LH side of the case underneath instrument panel (Fig. 8).
- Remove heater core cover.

- Remove screw and retaining bracket at bottom of heater core.
- Remove heater core and seal from case.

#### Installation

- Position heater core and seal assembly into heater case. Install core retaining bracket and screw.
- Position heater cover and install four retaining screws.
- Install modesty panel on instrument panel. Install two retaining screws.
- Remove plugs from heater hoses.
- Install heater hoses on heater core using clamps. Fill cooling system to specifications. Refer to Section 27-02, Cooling System Service.

### Blower Motor and Wheel Assembly

- Disconnect blower motor wiring connector (Fig. 9).

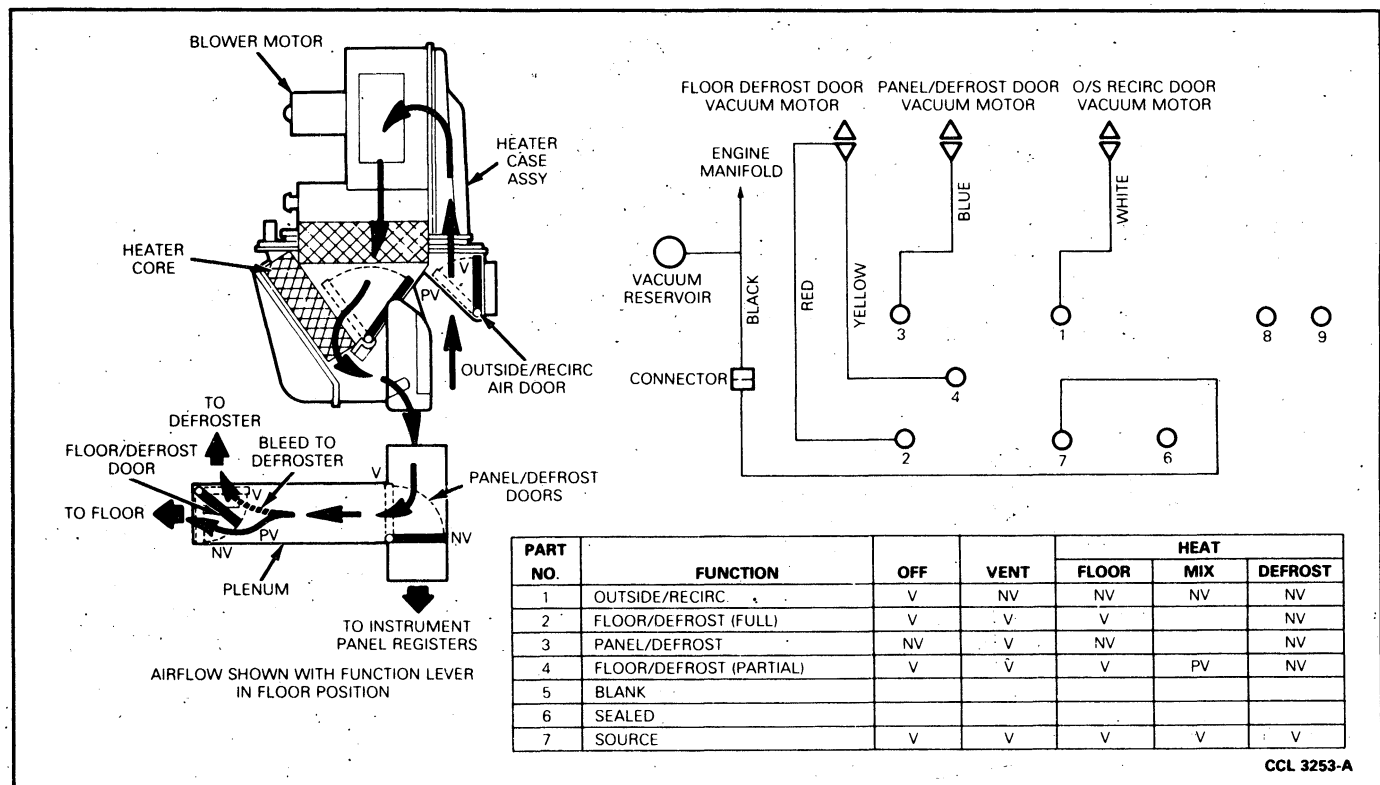


FIG. 5 Vacuum Diagram

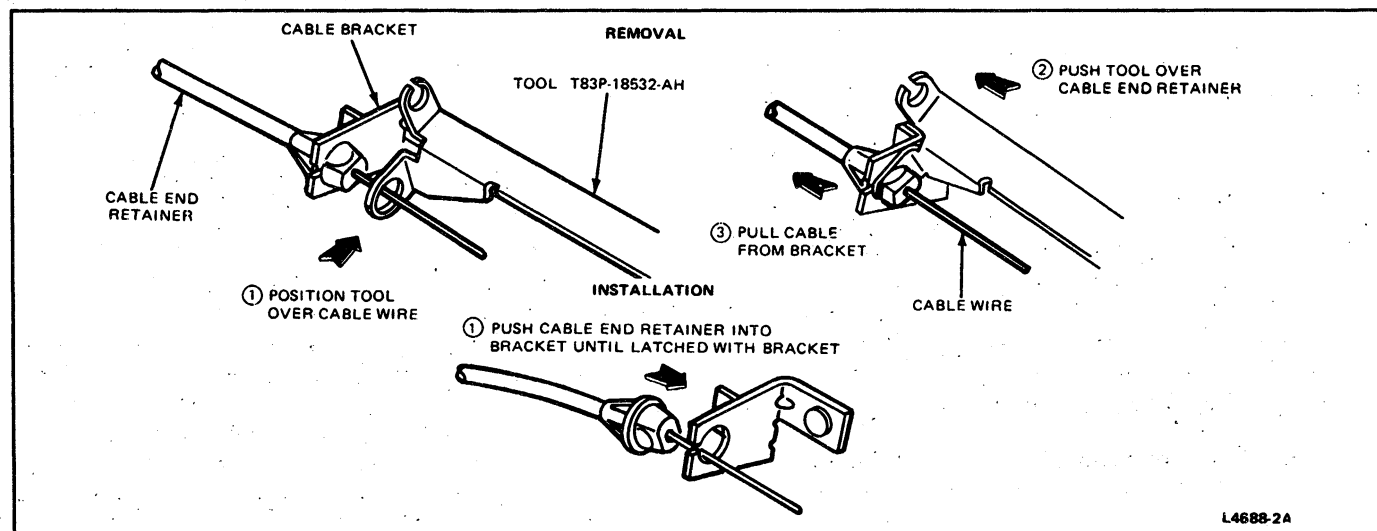


FIG. 6 Temperature Control Cable Removal and Installation

- Remove four screws retaining blower motor mounting plate to evaporator case assembly.
- Remove motor and wheel assembly from evaporator case.
- If the wheel is to be used on the new motor, install it on motor shaft so that distance from mounting plate to base of wheel is the same as the old motor installation.
- Install four retaining screws.
- Connect electrical wiring connector to blower motor.
- Check blower motor for proper operation.

#### Installation

- When wheel is properly installed on new motor, insert wheel into evaporator case and align locator pins with the holes in the base plate.

#### Instrument Panel

NOTE: It will be necessary to remove and install the instrument panel to service some components in the heater systems. Refer to Section 45-61, Instrument Panel and Pad.

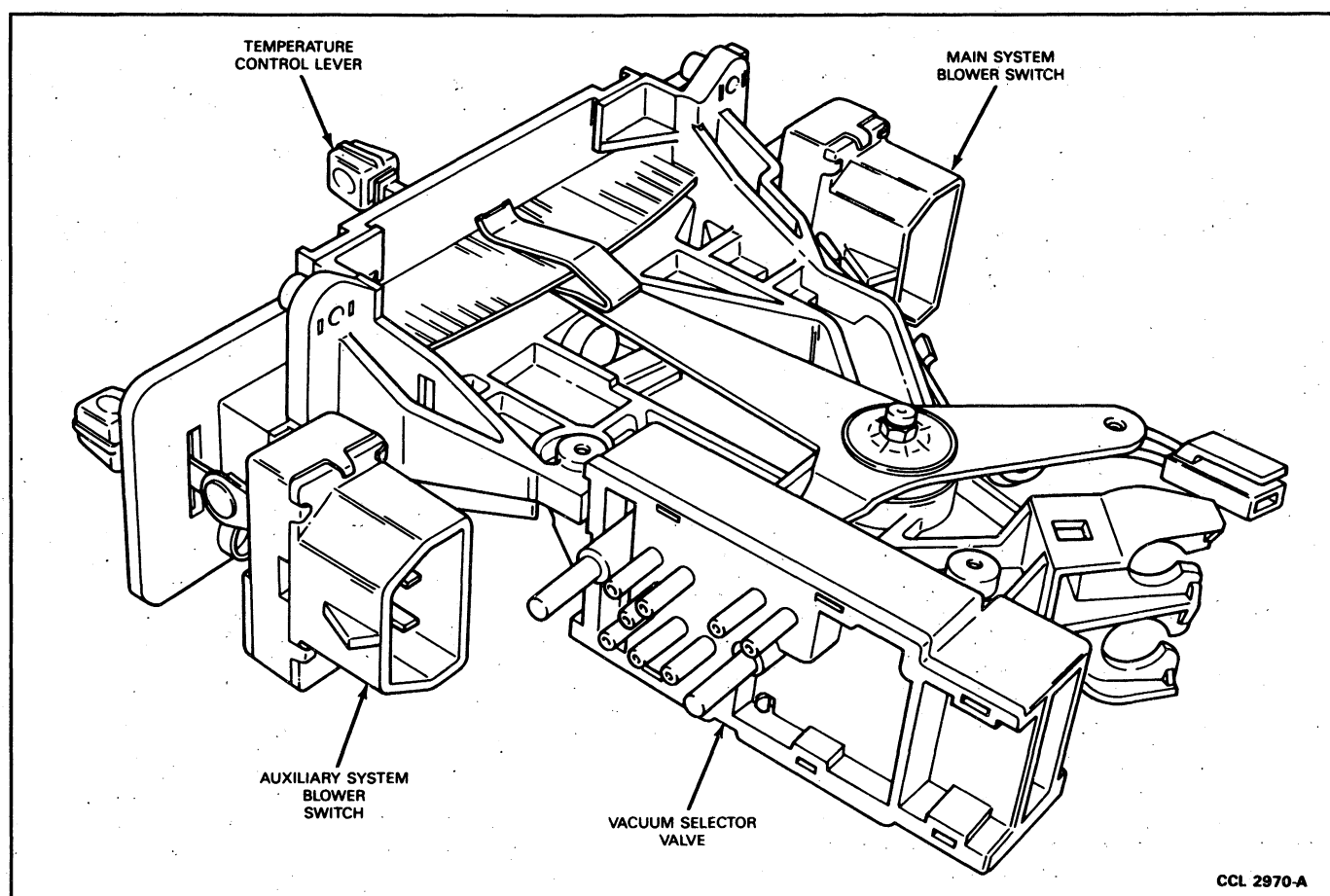


FIG. 7 Vacuum Selector Valve

### Air Ducts

To remove the heater outlet LH duct, it is necessary to remove the instrument panel cluster as outlined in Section 33-51, Instrument Cluster and Printed Circuit.

### LH Register Duct

#### Removal

1. Remove retainer attaching LH register duct to center register duct (Fig. 10).
2. Pull LH register duct from center register duct.

#### Installation

1. Position LH register duct to center register duct and align retainer holes.
2. Install retainer that attaches LH register duct to center register duct.

### Center Register Duct

#### Removal

1. Remove instrument panel. Refer to Section 45-61, Instrument Panel and Pad.
2. Remove LH register duct as outlined.
3. Disengage vacuum harness locator tab from center register duct.
4. Remove one retainer attaching center register duct to plenum.

5. Remove one nut retaining heater air outlet duct, LH heat duct and center register duct support braces to brake pedal support (Fig. 10).
6. Disengage center register duct support brace from clip bolt and remove center register duct.

#### Installation

1. Position RH end of the center register duct to plenum and support brace at LH end of duct to clip bolt.
2. Install LH heat duct support brace on the clip bolt and install retaining nut.
3. Install retainer attaching center register duct to plenum (Fig. 10).
4. Connect vacuum harness locator tab to center register duct.
5. Install LH register duct as outlined.
6. Install instrument panel. Refer to Section 45-61, Instrument Panel and Pad.

### Heater Ducts

#### Removal

1. Remove instrument panel. Refer to Section 45-61, Instrument Panel and Pad.
2. Remove one nut attaching LH heat duct, floor outlet duct and center register duct support braces to brake pedal support (Fig. 10).
3. Disengage wiring harness locator tabs and vacuum harness locator tab from heater air outlet duct.

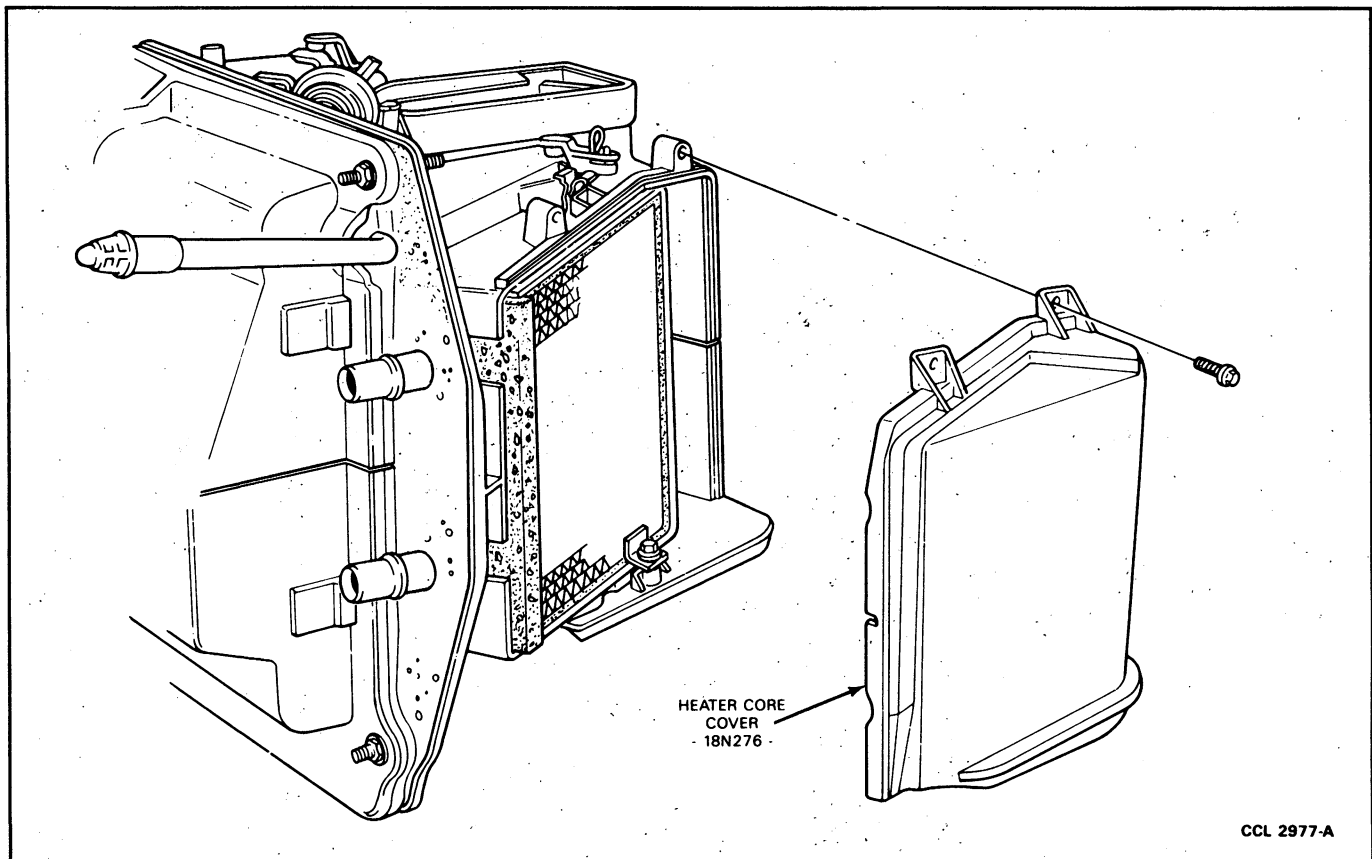


FIG. 8 Heater Core Cover Removal

4. Remove one retainer attaching LH heat duct to heater air outlet duct and remove LH heat duct.
5. Remove one retainer attaching heat duct to plenum (Fig. 10).
6. Disengage heater air outlet duct support brace from clip bolt on brake pedal support. Remove heater air outlet duct.

#### Installation

1. Position RH end of heater air outlet duct to plenum and support brace at LH end of duct to the clip bolt on the brake pedal support.
2. Place center register duct support brace on the clip bolt over heat duct brace.
3. Position LH heat duct to the heater air outlet duct and the support brace to the clip bolt.
4. Install nut retaining three support braces to the clip bolt. (Fig. 10).
5. Install one retainer attaching heat duct to plenum and one retainer attaching LH heat duct to heater air outlet duct.
6. Install wiring harness and vacuum harness locator tabs in their respective location on the heater air outlet duct.
7. Install instrument panel. Refer to Section 45-61, Instrument Panel and Pad.

#### Plenum Chamber

The plenum chamber is located under the instrument panel on top of the blower motor housing. For servicing the plenum-chamber, vacuum harness, and plenum

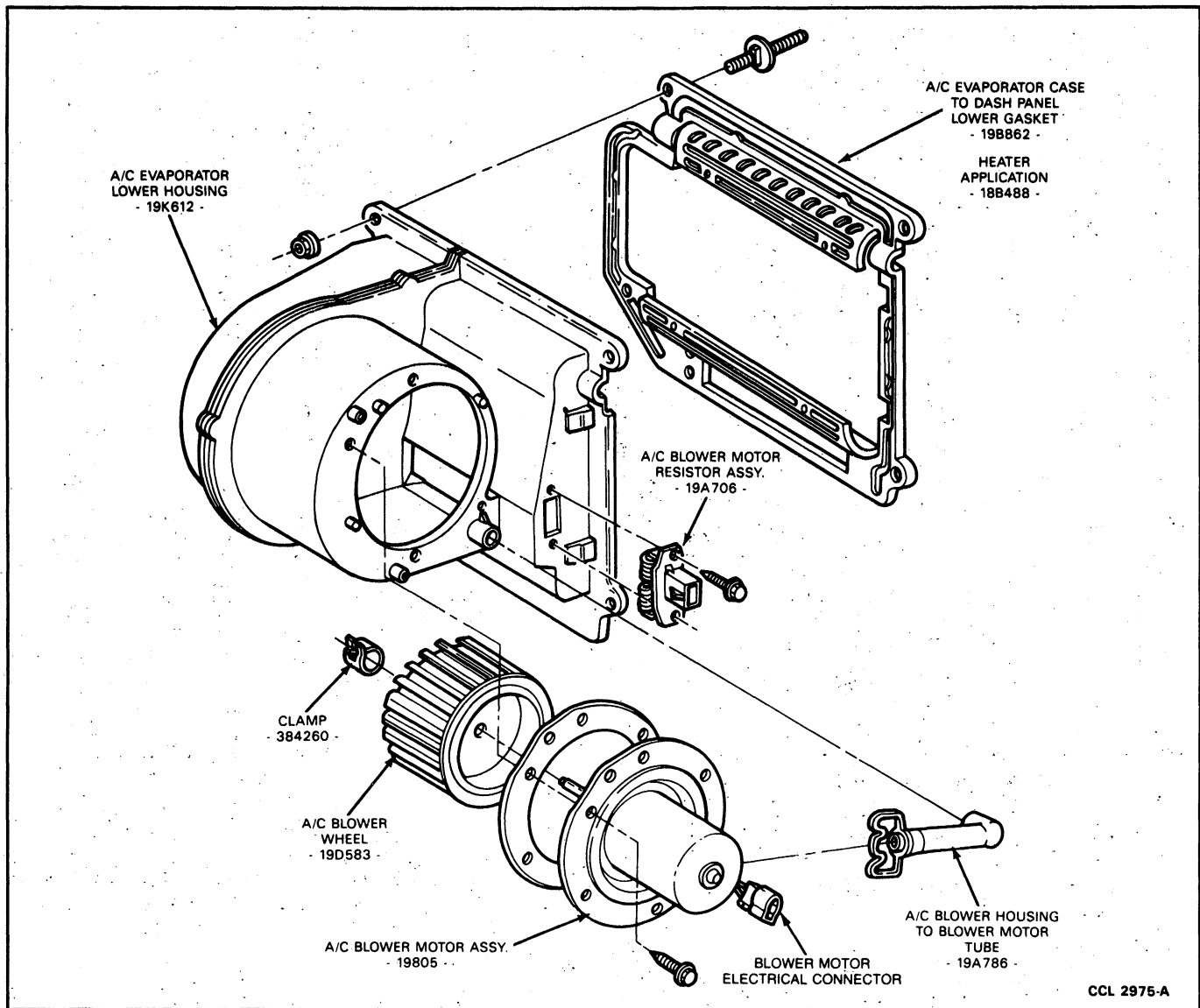
doors, it is necessary to remove the instrument panel as outlined in Section 45-61, Instrument Panel and Pad. It is not required to remove the instrument panel to service the vacuum motors attached to the plenum (Fig. 11).

#### Removal

1. Disconnect vacuum hoses from panel/defrost vacuum motor and floor/defrost vacuum motor.
2. Remove one retainer attaching center register duct to plenum and one retainer attaching heater air outlet duct to the plenum.
3. Separate plenum from evaporator-heater housing, center register duct, and heater air outlet duct and remove plenum.
4. Remove panel/defrost and floor/defrost vacuum motors from plenum.

#### Installation

1. Install panel/defrost and floor/defrost vacuum motors on plenum (Fig. 12).
2. Position plenum to center register duct, heater air outlet duct and evaporator-heater housing. Ensure clip on plenum is hooked over flange on evaporator-heater housing.
3. Install one retainer attaching center register duct and one retainer attaching heater air outlet duct to plenum. (Fig. 10).
4. Connect blue vacuum hose to top (end) of floor/defrost vacuum motor.



**FIG. 9 Blower Motor and Wheel Assembly**

5. Connect yellow vacuum hose to top (end) of panel/defrost vacuum motor and red vacuum hose to side of panel/defrost vacuum motor.
6. Install instrument panel. Refer to Section 45-61, Instrument Panel and Pad.
7. Check system for proper operation.
2. Connect vacuum hose to vacuum motor and position motor to evaporator-heater case.
3. Install two screws retaining vacuum motor.
4. Install a new pushnut (Part No. 383358-S) or equivalent retaining motor arm on door crank arm, if necessary.
5. Check system for proper operation.

### Outside-Recirculating Air Door Vacuum Motor

#### Removal

1. Remove two screws retaining motor to evaporator heater housing (Fig. 13).
2. Carefully pry vacuum motor arm off "rosebud" clip on door crank.
3. Disconnect vacuum hose from outside/recirculation vacuum motor. Remove motor.

#### Installation

1. Snap vacuum motor over "rosebud" clip on door crank.

### Defroster Nozzle

To remove the defroster nozzle it is first necessary to remove the instrument panel. Refer to Section 45-61, Instrument Panel and Pad. Remove heater ducts and register ducts as outlined.

#### Removal

Refer to Fig. 10.

1. Remove two screws retaining defroster nozzle to each defroster opening near windshield.
2. Pull defroster nozzle from plenum and remove from vehicle.

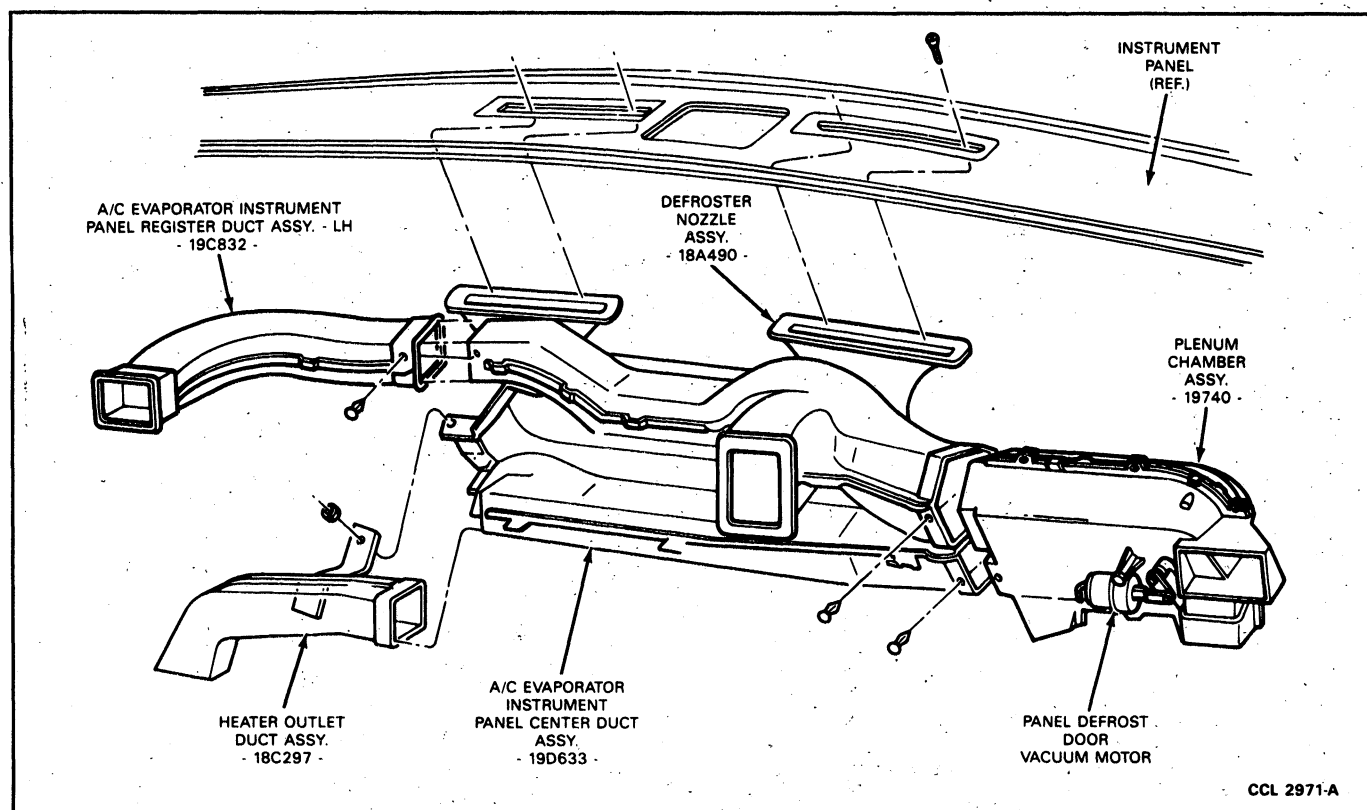


FIG. 10 Heater Duct and Defroster

**Installation**

1. Position defroster nozzle on plenum and the defroster openings.
2. Install two screws retaining defroster nozzle to each defroster opening.
3. Install register ducts and heater ducts as outlined in this Section.
4. Install instrument panel. Refer to Section 45-61, Instrument Panel and Pad.
5. Check system for proper operation.

**Register Louver Assembly****Removal**

1. Insert a thin-blade screwdriver under the retaining tab (Fig. 14) and pry tab toward louvers until it clears the hole in register assembly.
2. Pull louver end out from register opening only enough to prevent the louver pivot from going back into pivot hole.
3. Repeat Step 1 for other retaining tab and pull louver assembly from register opening.

**Installation**

The pivots on each end of some louver assemblies are different diameters and therefore determine the installed position. Other louvers have an arm extending inward on one end of the louver assembly. This end of the louver should be installed in the register assembly at the same end as the raised boss in the register assembly.

1. Position louver assembly into register opening.

2. Depress retaining tabs and push louver assembly into register opening and engage tabs in pivot holes.

**Right Register Assembly**

1. Remove louver assembly from register assembly.
2. Using a small-blade screwdriver or similar tool, pry register retaining tabs toward register opening. Push adapter retaining tabs out of the LH and RH sides of register housing. Then, pull register from instrument panel opening and register duct (Fig. 15).

**Installation**

1. Position register assembly in the instrument panel opening. When louvers move to the right when closing, register installation is correct.
2. While supporting register adapter, push register assembly into instrument panel opening and register duct until register tabs lock into place behind instrument panel opening flanges and into the adapter.

**Center Register Panel Assembly****Removal**

1. Disconnect battery ground cable.
2. Remove control knobs from radio shafts, if so equipped.
3. Disconnect wire from cigar lighter, if so equipped.
4. Unsnap name plate from its recessed location to the right of the registers, if so equipped.

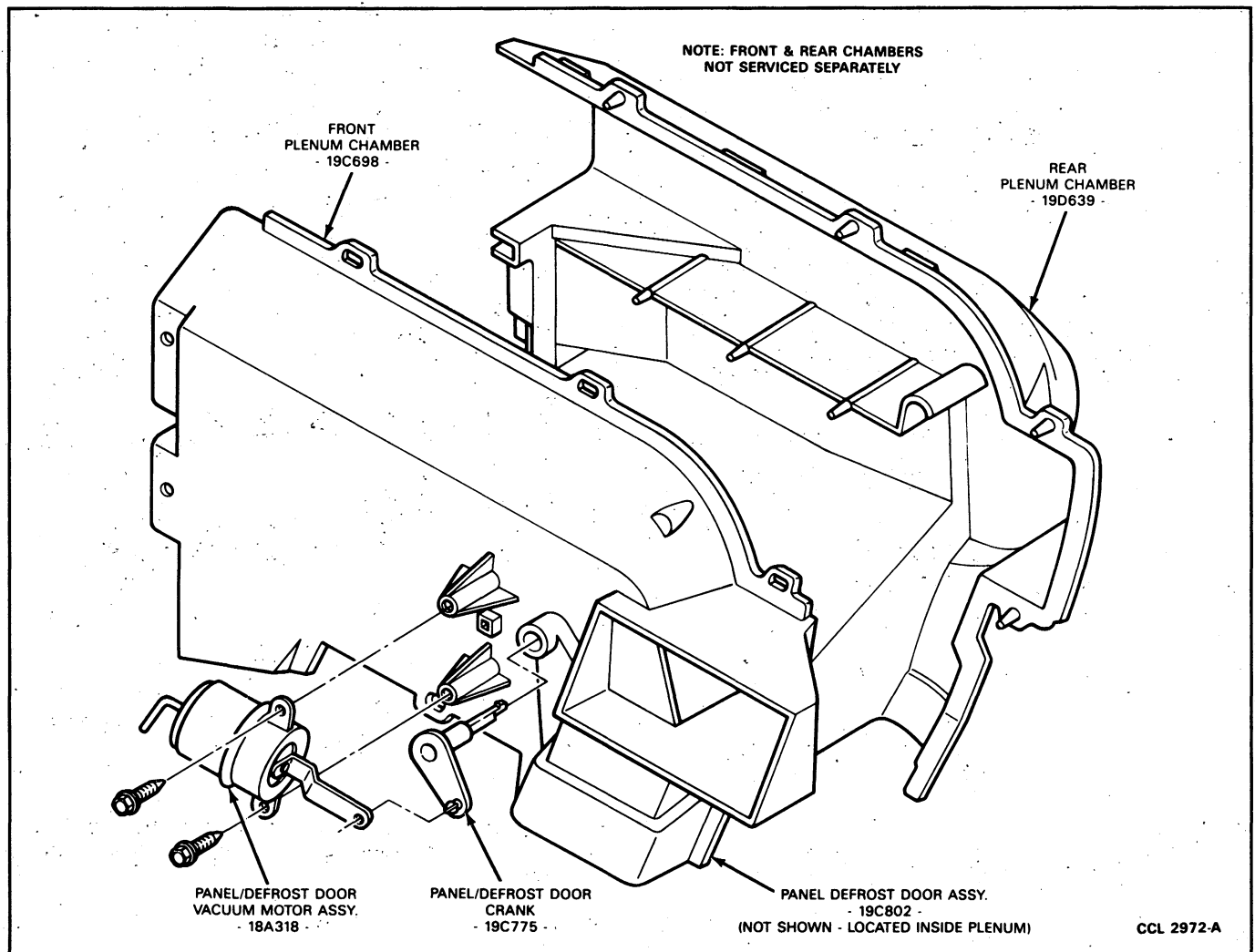


FIG. 11 Plenum Chamber

5. Remove six screws (five without nameplate) retaining register panel assembly to instrument panel (Fig. 16).
6. Pull register panel assembly from instrument panel, unsnapping two clips at the right end of register panel.

**Installation**

1. Position register panel assembly in the instrument panel and engage two snap clips.
2. Install register panel assembly attaching retaining screws.
3. Install nameplate, if so equipped.
4. Connect wire to cigar lighter, if so equipped.
5. Install control knobs on radio shafts, if so equipped.
6. Connect battery ground cable.

**Left Register Assembly****Removal**

1. Disconnect battery ground cable.
2. Remove ignition lock cylinder and ignition switch bezel.
3. Remove headlamp switch knob and shaft. Then, remove headlamp switch bezel.

4. Remove knob from windshield wiper switch.
5. Remove two screws retaining left register panel to instrument panel (Fig. 16).
6. Pull register panel assembly away from instrument panel to disengage snap clips at top of register panel.

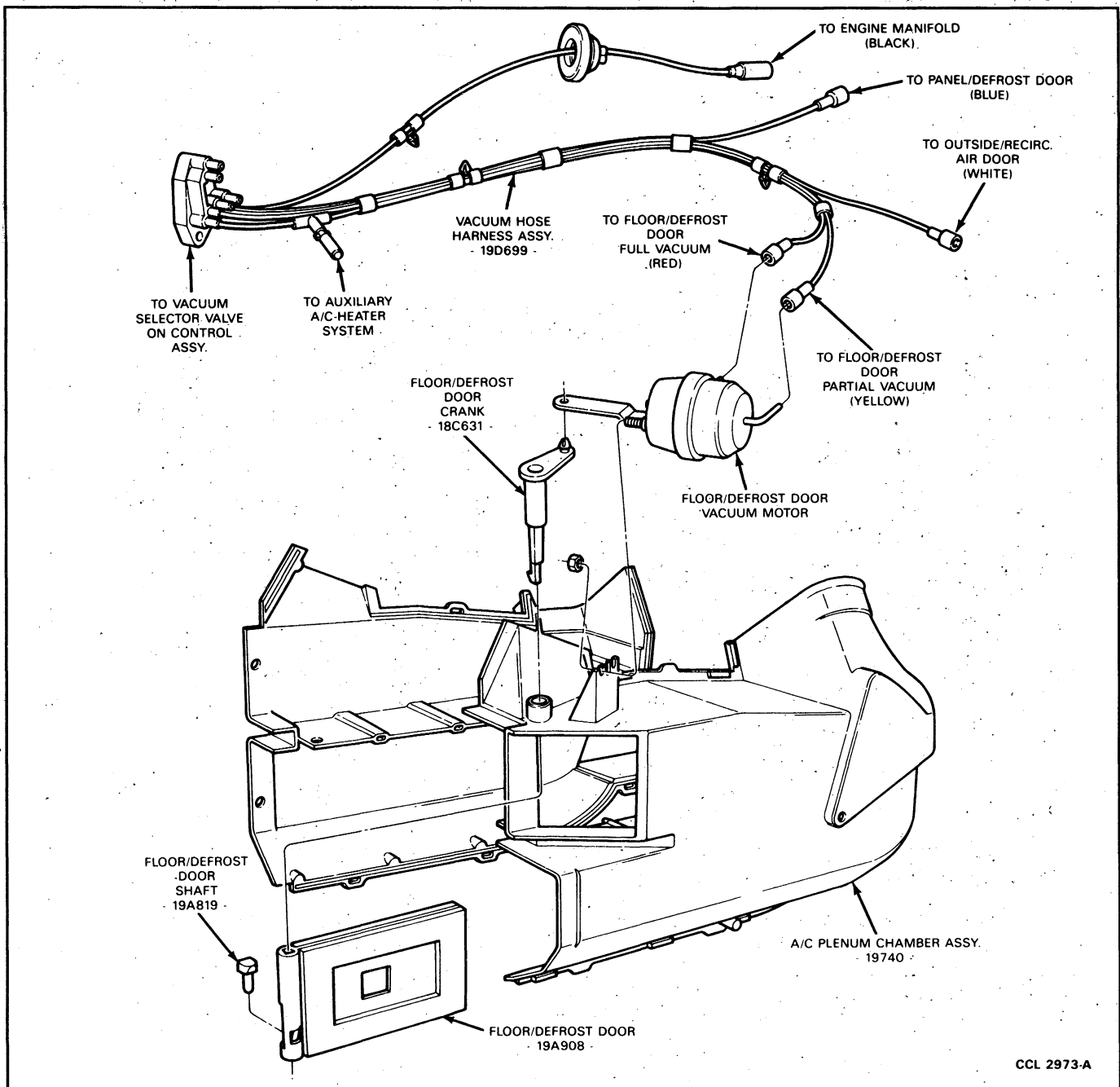
**Installation**

1. Position register panel to instrument panel and push to engage snap clips.
2. Install two screws retaining lower edge of register panel to instrument panel.
3. Install headlamp switch bezel, knob and shaft assembly.
4. Install ignition switch bezel and ignition switch lock cylinder.
5. Install windshield wiper switch knob.
6. Connect battery ground cable.

**Heater Blower Assembly**

There are five tee shoulder pilot studs which pass through holes in the instrument panel, located around the edges of a large cutout in the panel. This cutout is an opening between the heater blower housing assembly (Part No. 18456) on the engine compartment side of the instrument panel and the A/C evaporator





CCL 2973-A

**FIG. 12 Typical Vacuum Motor to Plenum Installation and Vacuum Harness Assembly**

core rear housing assembly (Part No. 19A583) on the passenger compartment side of the panel. Nut and washer assemblies draw the two major components together through their gaskets at the instrument panel.

A disassembled view of the components in the heater blower housing assembly is shown in Figure 18.

The disassembled view illustrates the attaching locations of the blower motor resistor assembly and the blower housing to blower motor tube.

### Heater Hose Installation

Figures 19 through 23 illustrate heater hose installations for the 4.9L (300 CID), 5.0L (302 CID), 5.8L (351 CID), 7.5L (460 CID), and 7.3L (445 CID) diesel engines.

### Quick Connect/Disconnect Hose Couplings

The quick connect and disconnect tools for hoses having a quick connect coupling are shown in Figure 24.

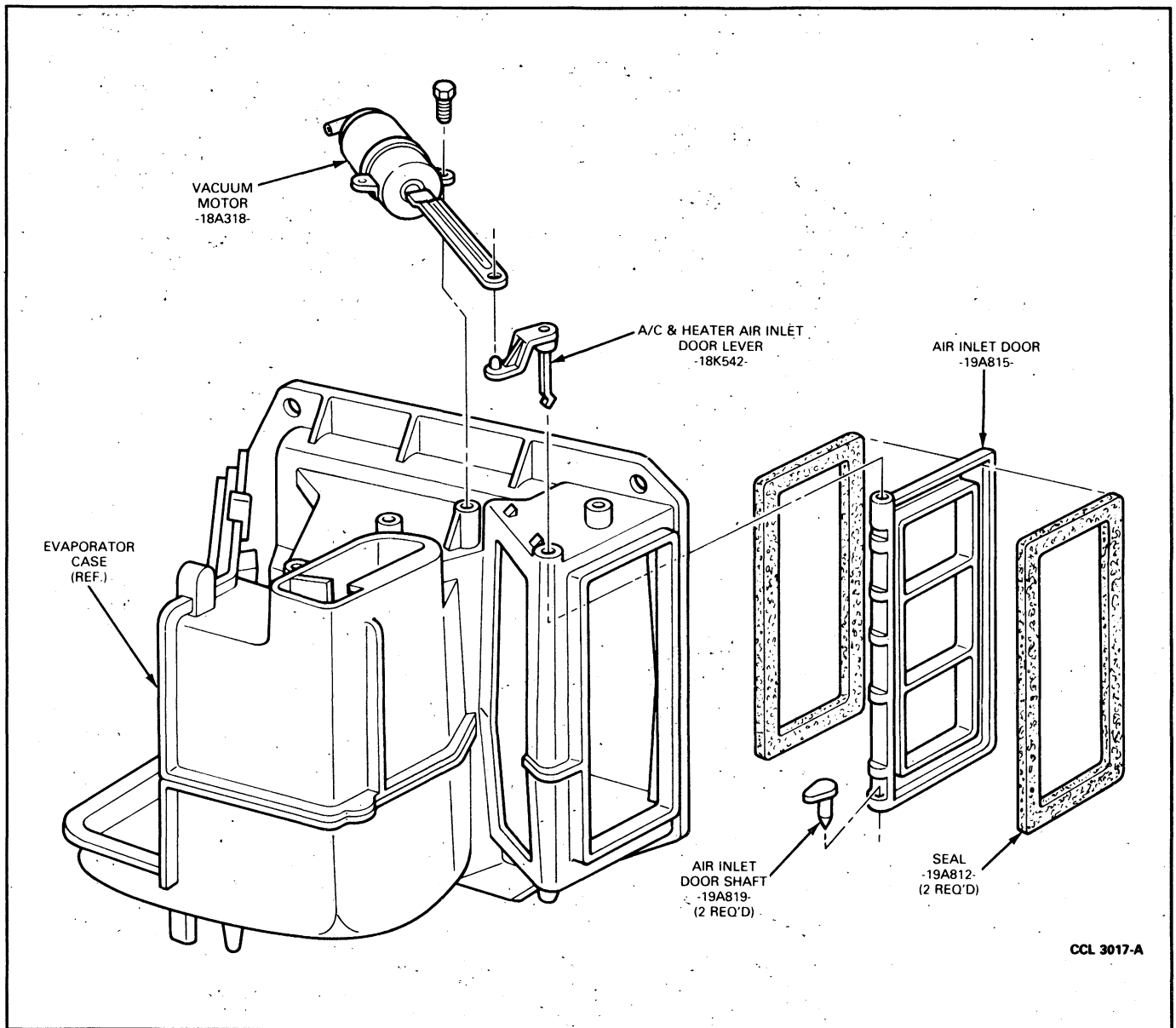


FIG. 13 Outside/Recirc Air Door Vacuum Motor

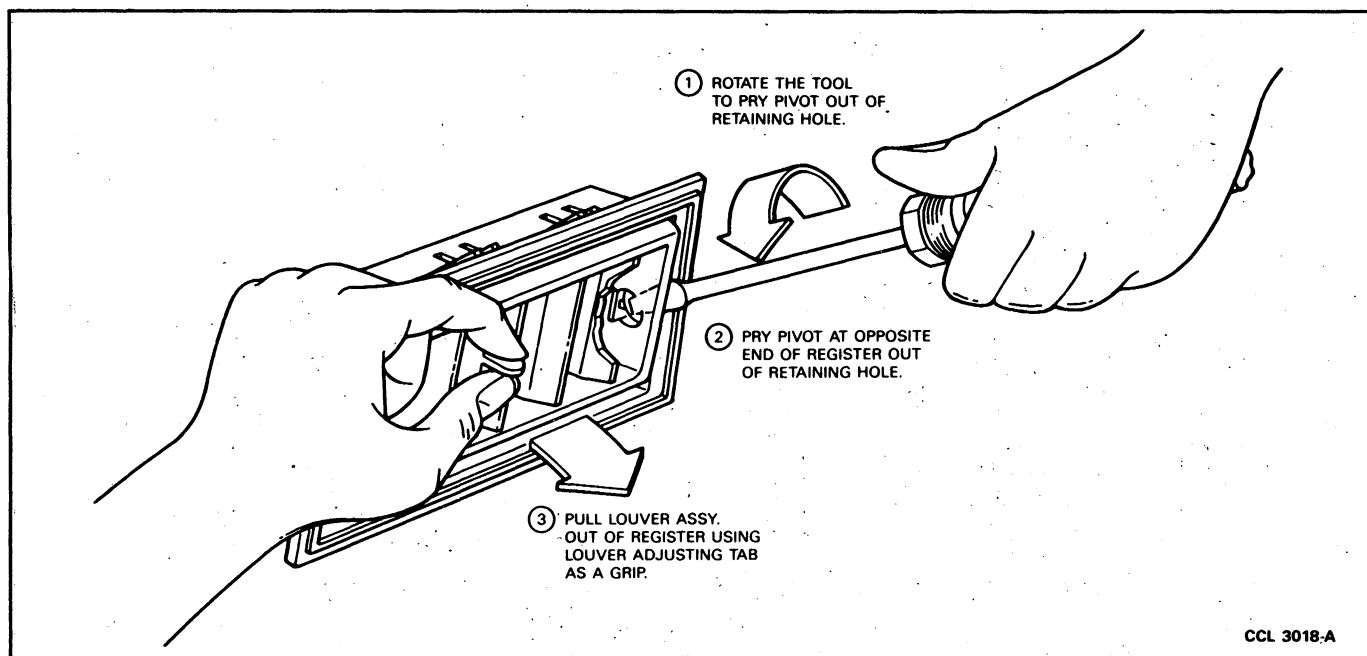


FIG. 14 Louver Removal

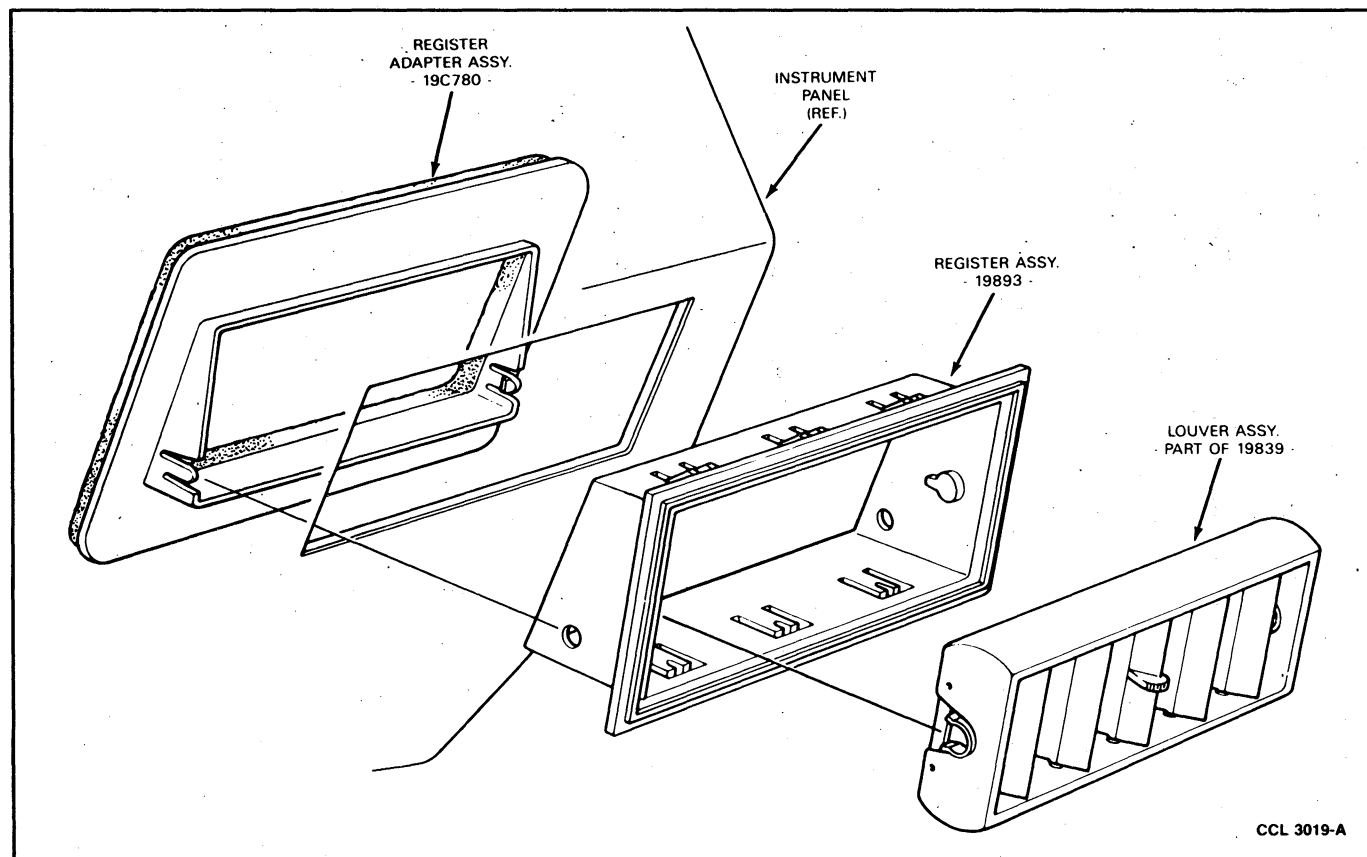
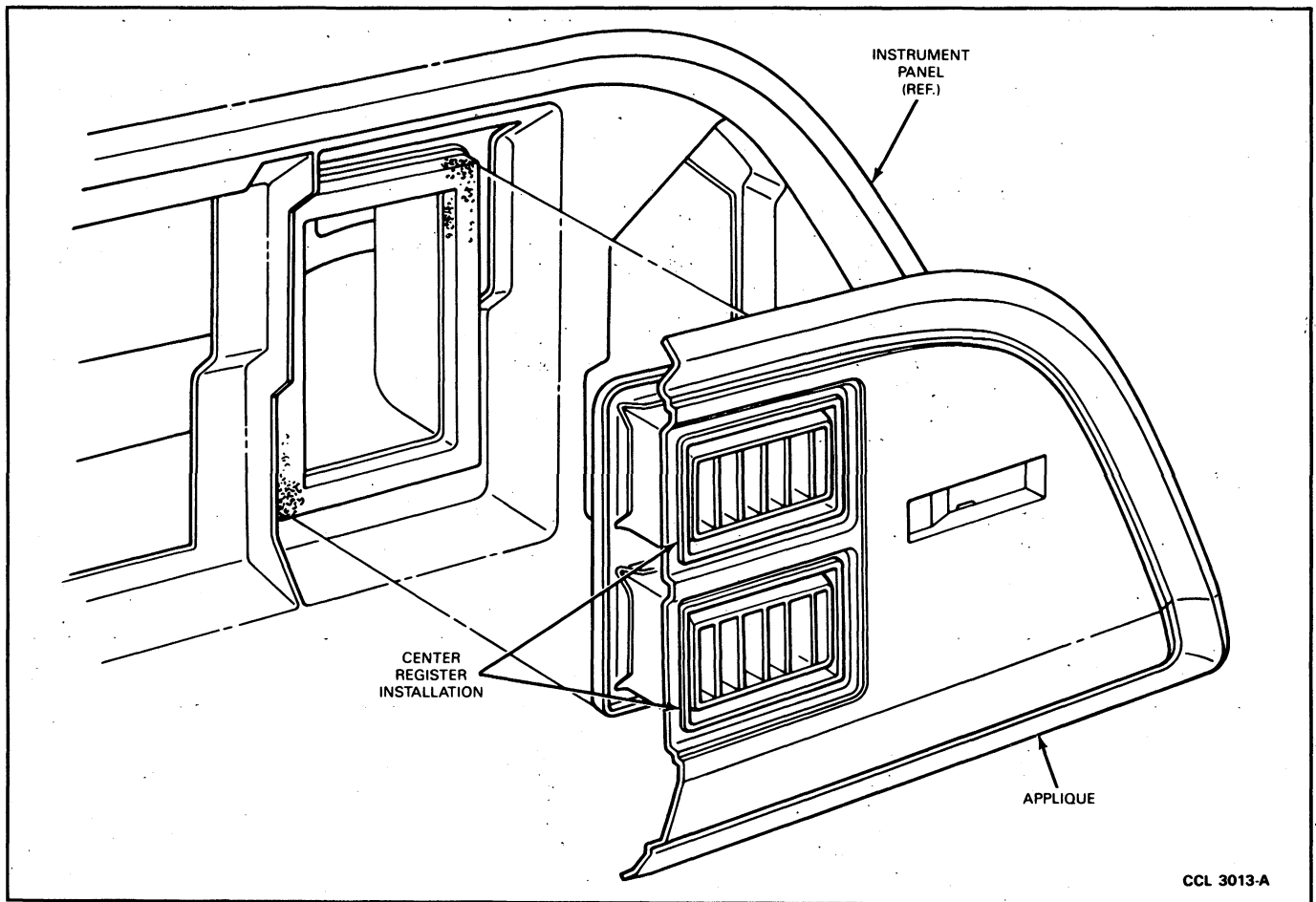
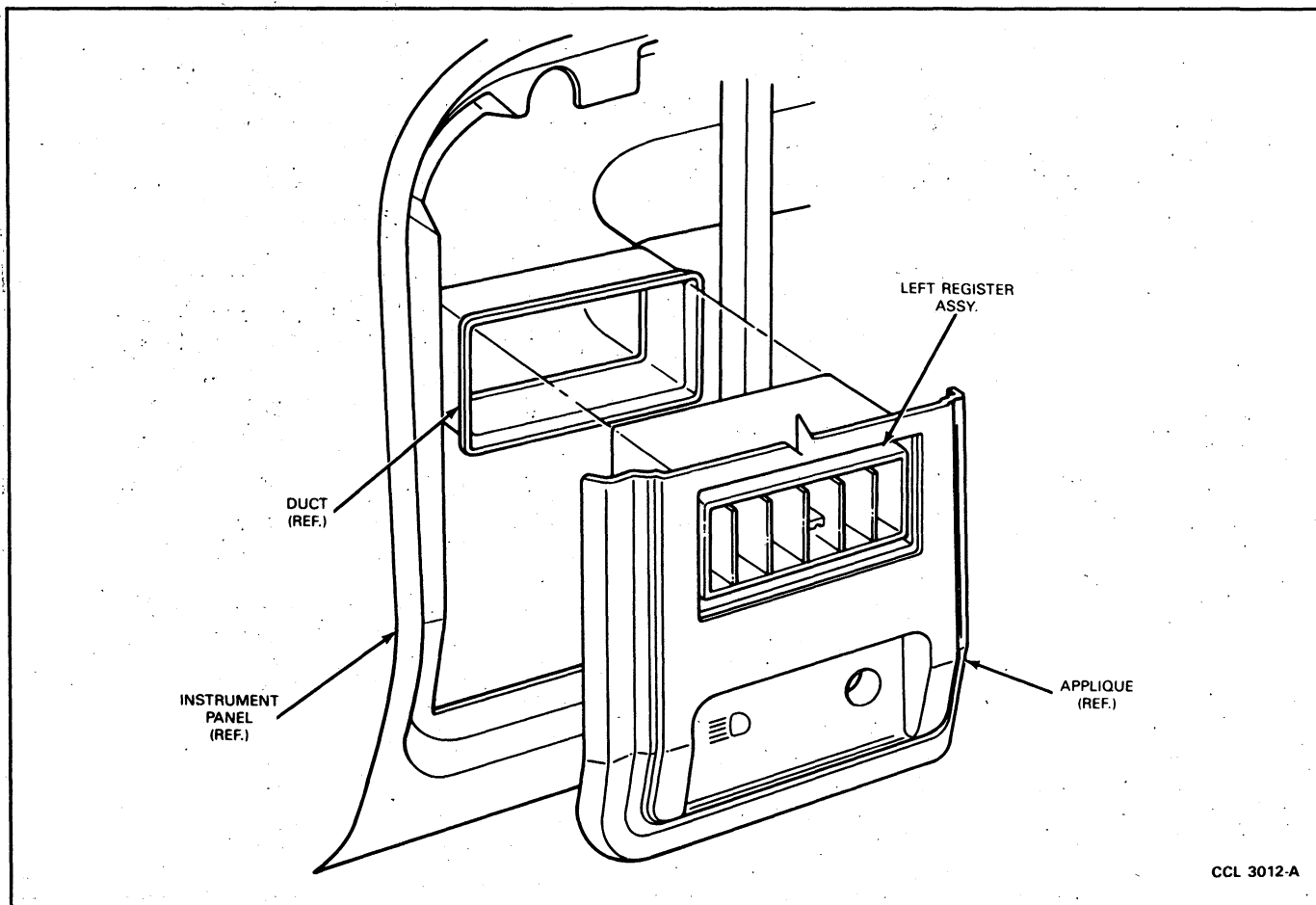


FIG. 15 Right Register Assembly



**FIG. 16 Center Register Assembly**



**FIG. 17 Right Register Assembly**

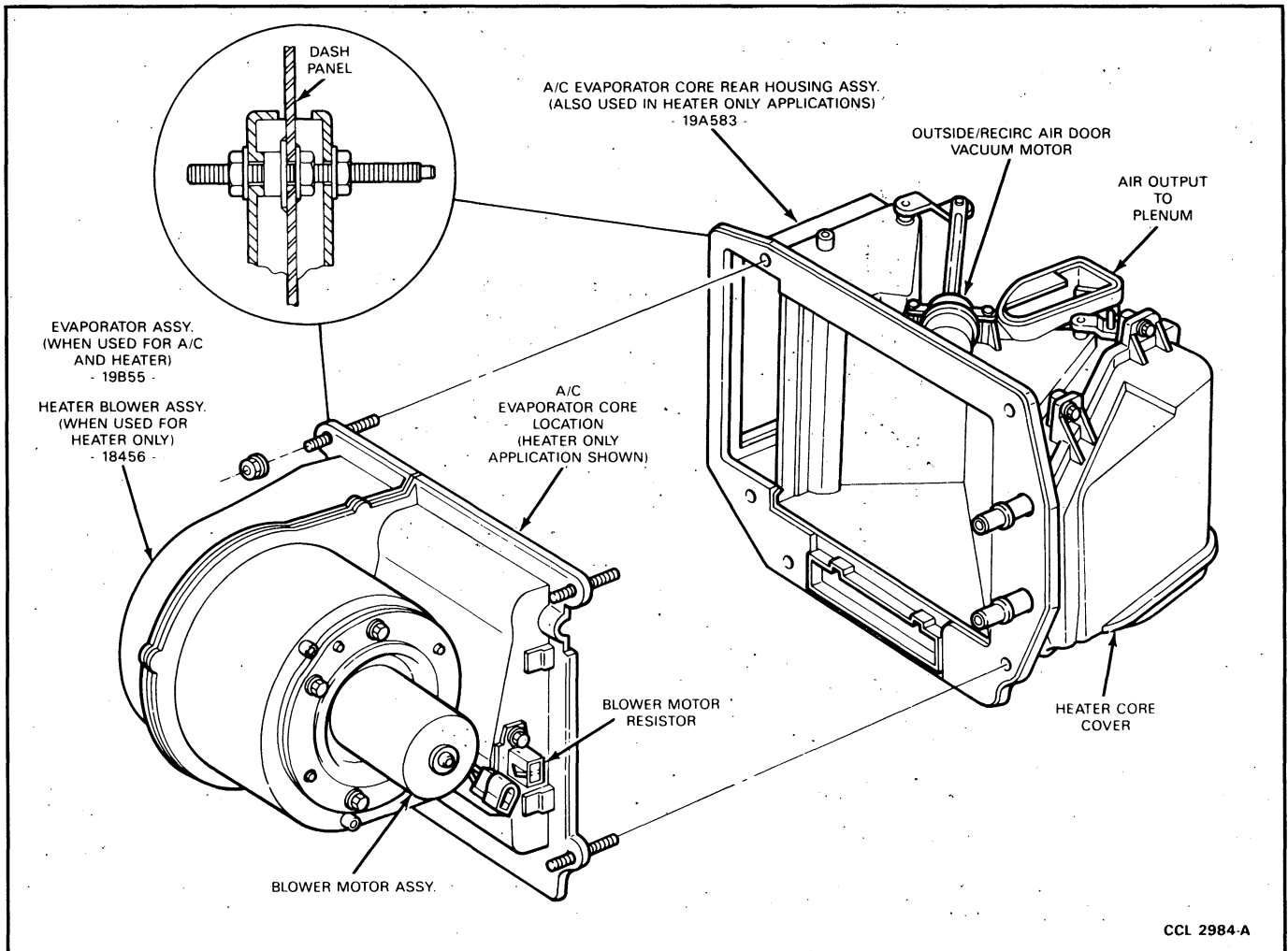


FIG. 18 Heater Blower Housing Assembly

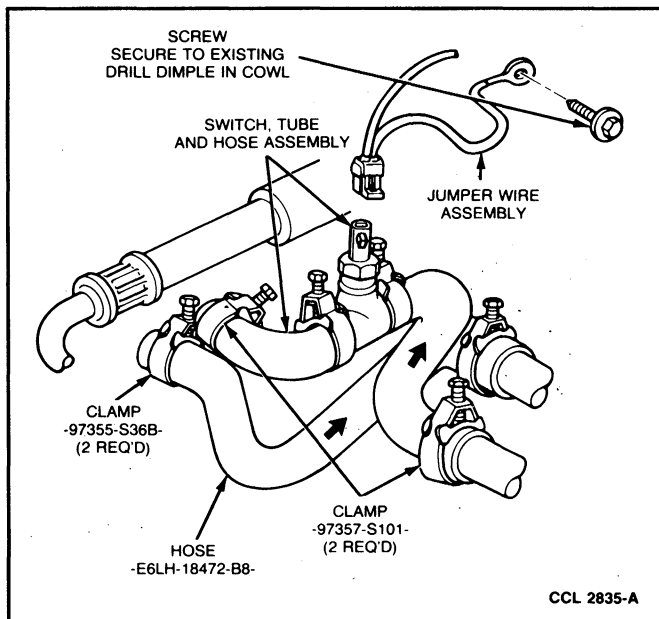


FIG. 19 Heater Hose Installation—4.9L (300 CID—6-Cylinder) Engine

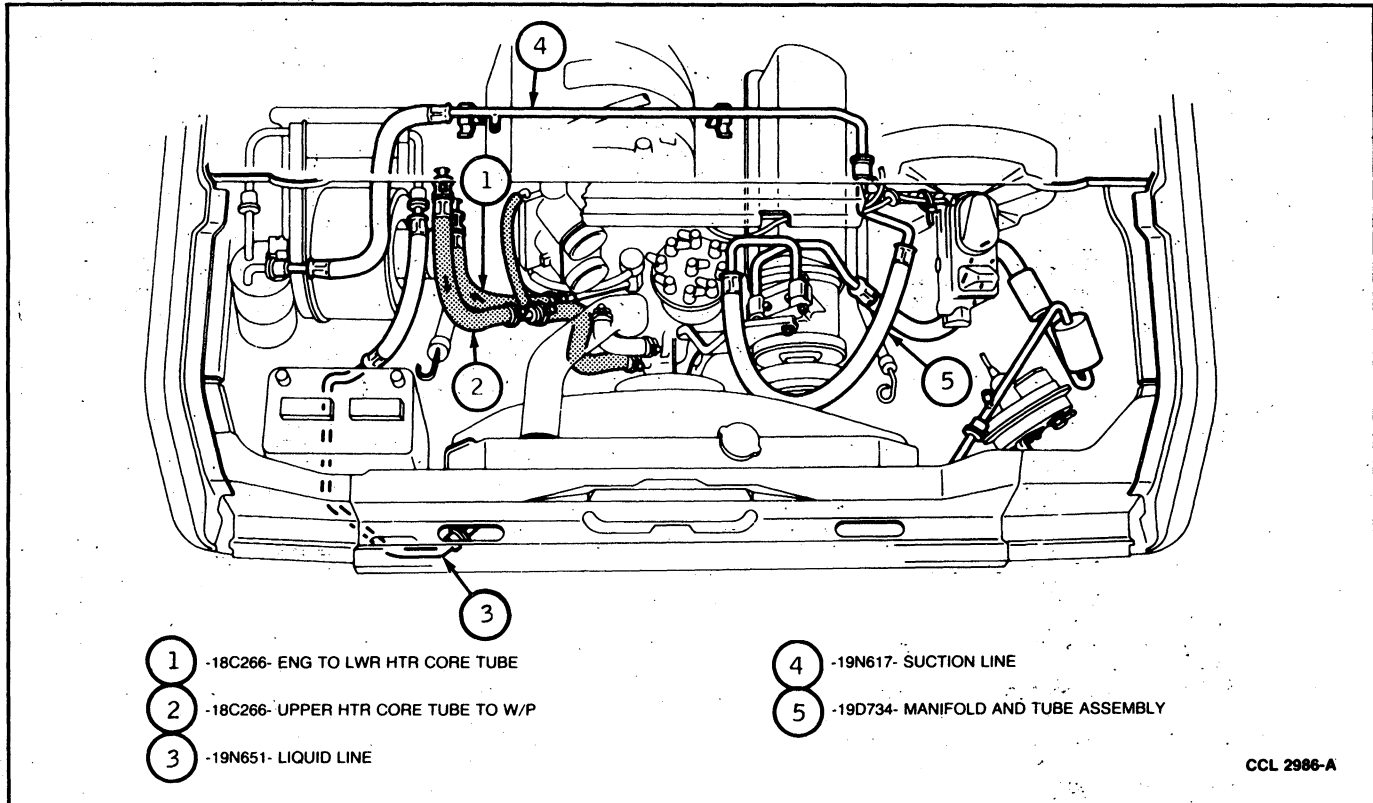


FIG. 20 Heater Hose Installation—5.0L (302 CID) 8-Cylinder) Engine

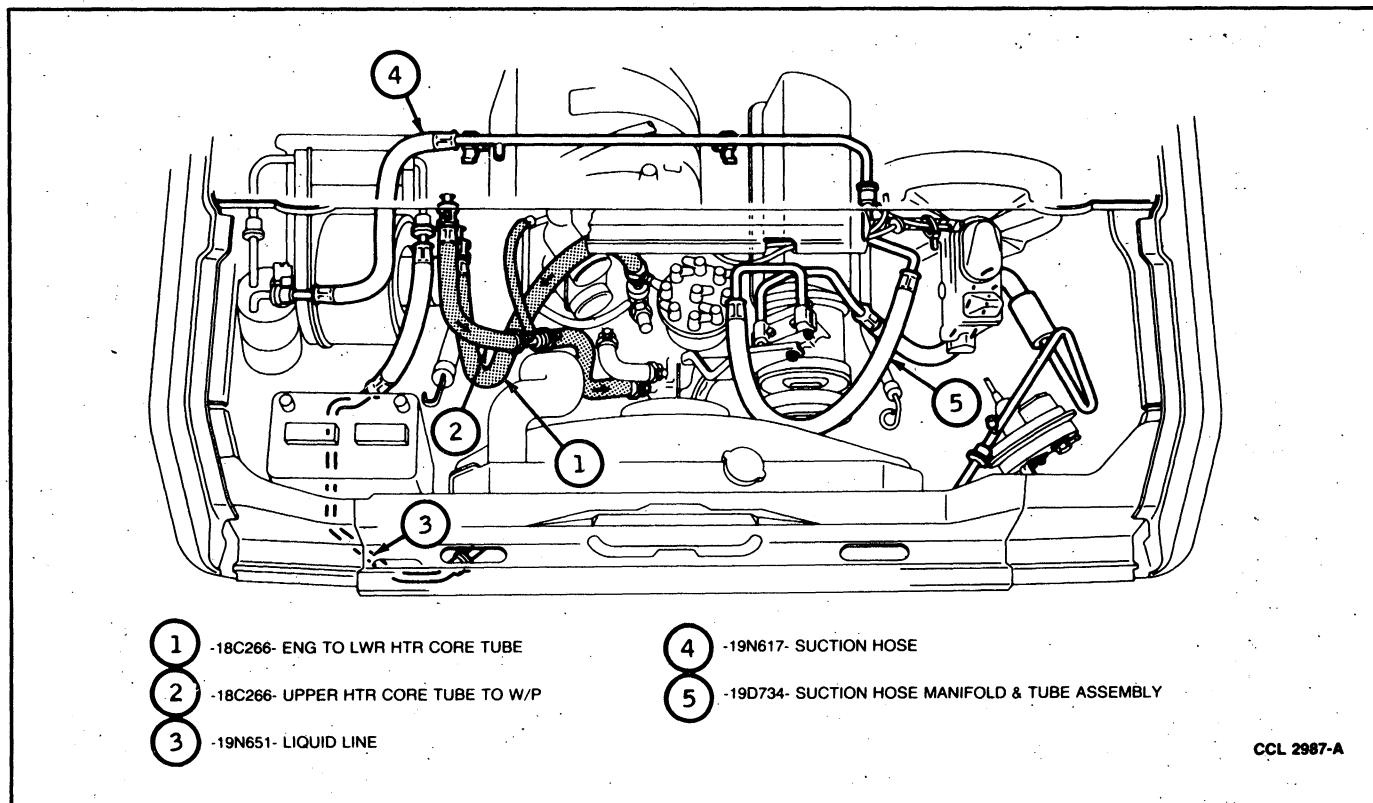
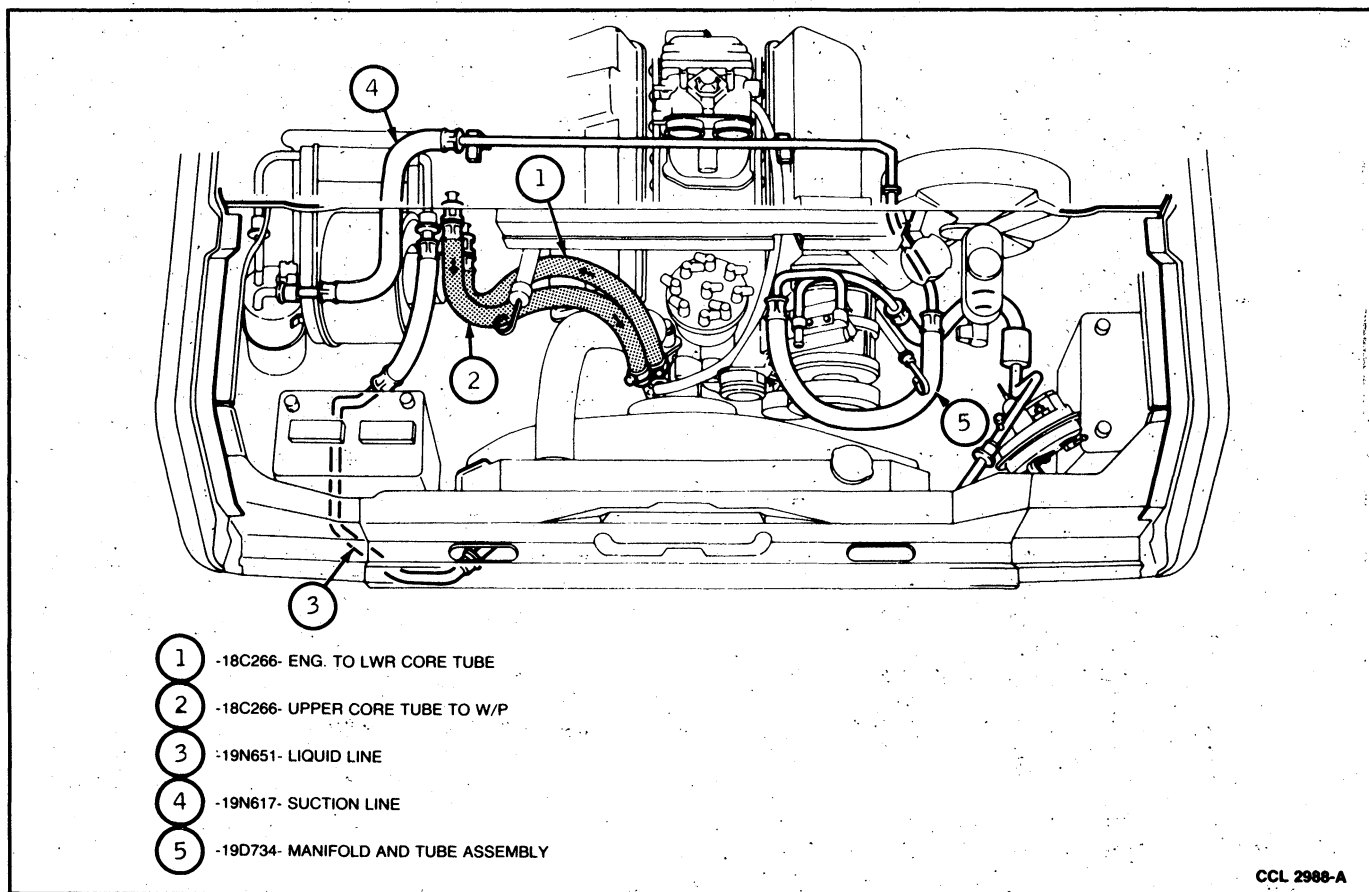
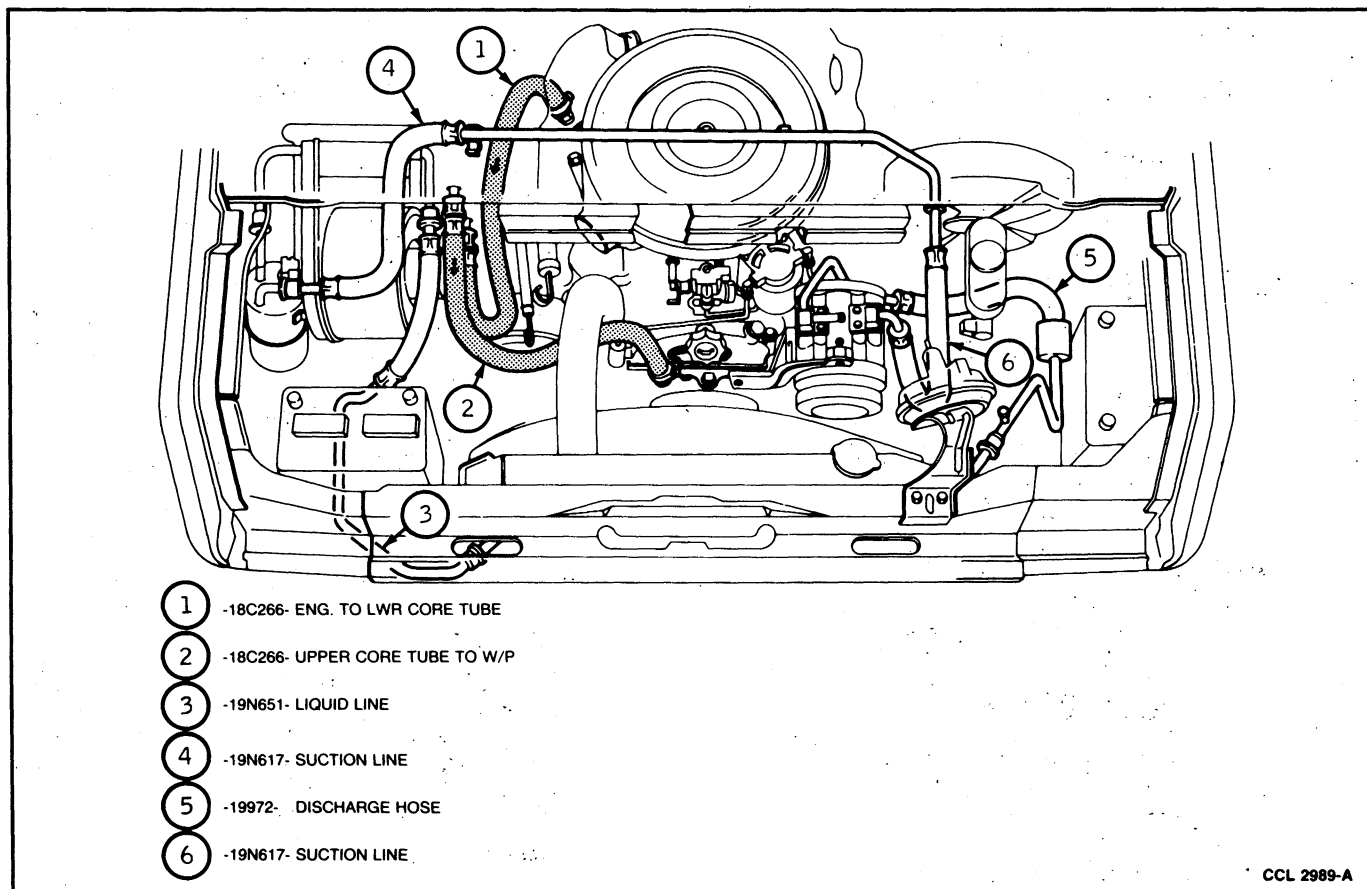


FIG. 21 Heater Hose Installation—5.8L (351 CID) 8-Cylinder) Engine



**FIG. 22 Heater Hose Installation—7.5L (460 CID) 8-Cylinder**





**FIG. 23 Heater Hose Installation—7.3L (445 CID) Diesel Engine**

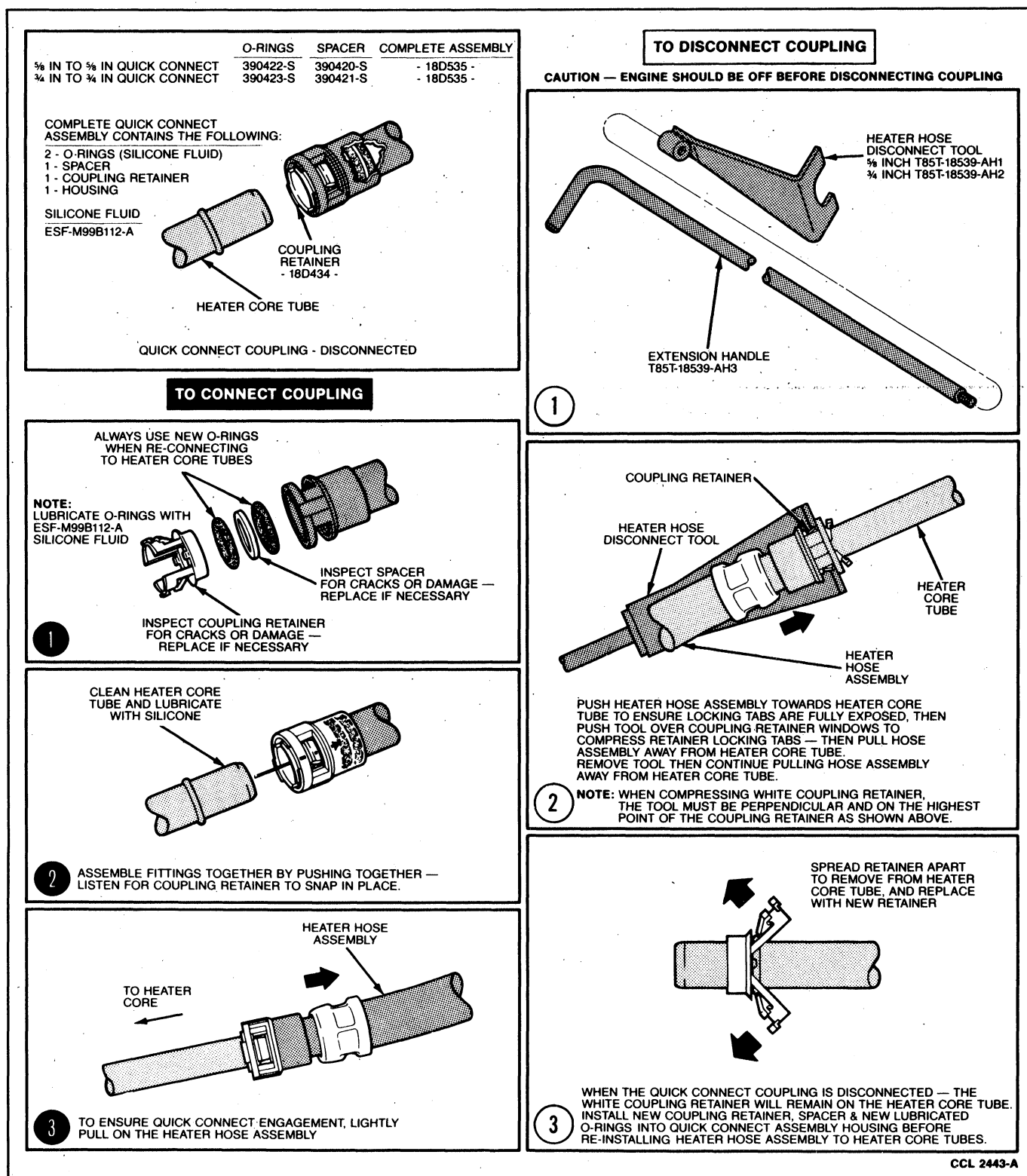


FIG. 24 Heater Hose Quick Connect Coupling Tool

## SPECIFICATIONS

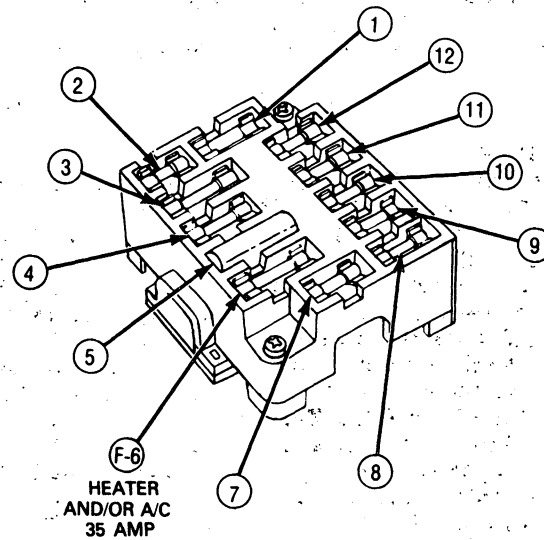
### ELECTRICAL

System Protection Blower Circuit	35 Amp Fuse in Fuse Panel (F-6)	
Blower Motor Current Draw	Amps	Volts
Switch Setting		
Low	4.0	4.0
Medium Low	7.3	6.0
Medium High	13.8	9.0
High	23.0	12.8
Illumination Control Assembly	One ICP-161 Bulb	

### TORQUE SPECIFICATIONS

Heater Hose Clamps	13 to 18 lb-in
--------------------	----------------

CL3460-2C



The fuse panel is located on the dash panel in passenger compartment left of the steering column.

CL3460-2C

## SPECIAL SERVICE TOOLS

### SPECIAL SERVICE TOOLS

Tool Number	Description
T83P-18532-AH	Heater Control Cable Disconnect Tool
T85T-18539-AH1	5/8-Inch Heater Hose Disconnect Tool
T85T-18539-AH2	3/4-Inch Heater Hose Disconnect Tool
Rotunda Vacuum Tester	021-00014

CK6838-1C

# SECTION 36-25 Heater and Ventilation System

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<b>DESCRIPTION AND OPERATION</b>		Heater Blower Assembly .....	36-25-10
Airflow Distribution .....	36-25-2	Heater Core .....	36-25-15
Blower Control .....	36-25-2	Heater Hoses .....	36-25-16
Function Control Vacuum Circuit .....	36-25-2	Heater Plenum Assembly .....	36-25-12
Temperature Selection .....	36-25-2	Heater Plenum Door Vacuum Motors .....	36-25-13
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## VEHICLE APPLICATION

F-150 Through F-350, F-Super Duty and Bronco Vehicles.

## DESCRIPTION AND OPERATION

The heater-ventilation system is a blend air design. Outside air is supplied to the system through the cowl top grille. This air supply enters the blower housing where the blower motor and wheel forces it through or around the heater core. Airflow through the plenum assembly is determined by the setting of the function control lever in the control assembly. The outlets through which air may be distributed into the passenger compartment are shown in Figure 1.

The heater blower assembly includes a polypropylene housing containing the following:

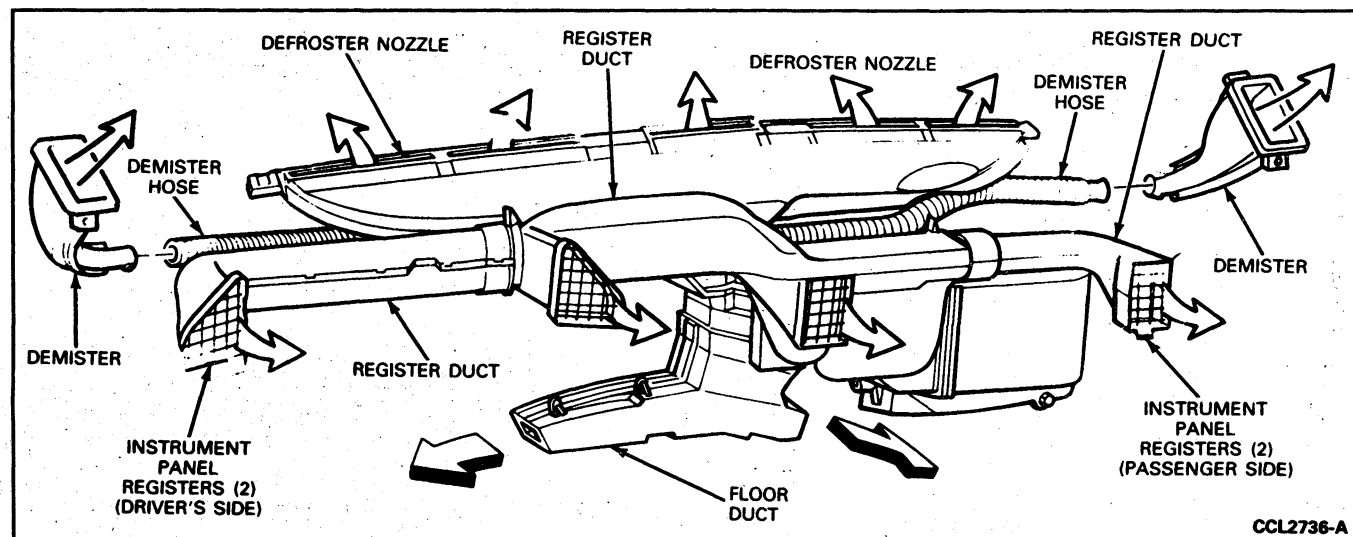
- motor and wheel
- motor resistor
- air door
- motor for door operation

Also included are harnesses required to energize the electrical and vacuum components in the assembly.

The heater blower assembly is located in the engine compartment and connects to the plenum assembly located under the instrument panel inside the vehicle.

The case containing the plenum chamber also contains the following:

- core
- door



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FIG. 1 Air Distribution—Heater-Ventilation System

door

blend or

motors and harness

The vacuum motors and vacuum harness operate the floor/defrost and vent/heater doors. The temperature blend door is operated mechanically by a cable attached to the temperature control lever in the control assembly.

Refer to Figure 1 to identify instrument panel ducts, floor duct, defroster nozzle, demister and demister hoses.

Figure 2 illustrates the function control lever in each of its five positions. The five positions are: OFF, VENT, FLOOR, FLOOR/DEFROST, and DEFROST. The direction of airflow through the system in each of the function lever settings is shown in Figure 2.

The rate and volume of airflow is determined by the setting of the four-position blower switch lever. The blower switch lever is located near the left edge of the control assembly. The lever settings are: LOW, MEDIUM LOW, MEDIUM HIGH, and HIGH. The switch does not have an OFF position. To stop blower operation, the function lever must be in its OFF position.

The temperature control lever moves along the upper two slotted openings in the control assembly to indicate the amount of cool and/or warm air being directed through the system. The function lever moves through the lower slotted opening in the control assembly to any of the five positions as outlined previously.

To start airflow through the system, set the function lever in the desired position (VENT, FLOOR, FLOOR/DEFROST, or DEFROST). Set the blower switch in either of its four positions (LOW, MEDIUM LOW, MEDIUM HIGH or HIGH).

### Temperature Selection

Depending upon its position, the temperature blend door in the plenum chamber directs a given amount of outside air through the heater core to provide a desired amount of heat. As the amount of air directed by the blend door through the heater core is reduced, less heat will be directed in the passenger compartment.

### Airflow Distribution

The position of the function lever in the control assembly determines which of the damper doors are open, partially open, or closed as described below and illustrated in Figure 2.

the lever is in the OFF position, the OUTSIDE AIR door is closed to block the entry of air from the cowl into the plenum chamber.

the lever is in the VENT position, the OUTSIDE AIR door is open and the FLOOR/DEFROST door is open. The airflow is directed to the registers in the instrument panel. The position of the BLEND AIR door, based upon the setting of the temperature lever in the control assembly, may be set as desired between cool and warm to obtain the desired blend of cool or heated air.

the lever is in the FLOOR position, the OUTSIDE AIR door is open. Airflow is directed through the TEMPERATURE BLEND door opening, through the heater core, past the closed PANEL/DEFROST door, and out through the open FLOOR/DEFROST door to

the floor outlets. There will be an air bleed past the closed DEFROST door to the defrosters.

the lever is in the FLOOR/DEFROST position, the airflow follows the same path as described for FLOOR position, except the FLOOR/DEFROST door is in the partial vacuum or mid-position. This allows equal amounts of airflow to the floor outlet and defrosters.

the lever is in the DEFROST position, the FLOOR/DEFROST door is fully open to the defroster nozzle with a bleed amount going past the closed door to the floor outlet.

### Function Control Vacuum Circuit

Figure 3 is a diagram illustrating the vacuum hose connections between the vacuum source, vacuum motors, and vacuum selector valve. The diagram also identifies the color coding of the vacuum hoses and charts the function lever settings and vacuum application by vacuum selector valve port and function.

### Blower Control

The four operating speeds (LOW, MEDIUM LOW, MEDIUM HIGH, and HIGH) which are controlled by a resistor assembly which is connected in series with three of the blower switch operating positions and the blower motor ground (Fig. 4). The MEDIUM LOW and MEDIUM HIGH switch positions on the control assembly are identified by asterisks rather than word callouts.

With the switch in its LOW position, current flow in the motor ground circuit passes through three of the coils in the resistor. In MEDIUM LOW, current flows through two resistor coils. In MEDIUM HIGH, current flows through one resistor coil. In HIGH, current flow in the motor ground circuit bypasses the resistor to provide maximum blower speed.

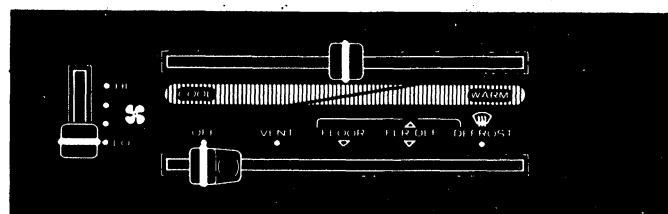
## DIAGNOSIS AND TESTING

### Blower Motor Voltage Test

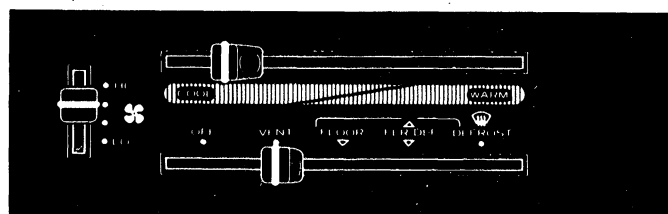
1. Place temperature selector lever in mid-range position (halfway between COOL and WARM).
2. Place function control lever in PANEL position (air through registers).
3. Insert probes of Rotunda Digital Volt-Ohm Meter 007-00001 or equivalent, into connector at rear of blower motor and make contact with wire terminals. With engine running, measure voltage drop across motor.
4. With engine running (battery voltage approximately 14.2 volts), voltage reading should be within range specified for each blower motor lever position. Refer to Specifications.

### Blower Motor Current Draw Test

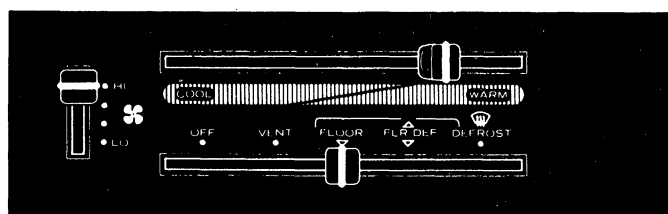
1. Disconnect blower motor electrical wire harness.
2. Connect Rotunda Digital Volt-Ohm Meter 007-00001 or equivalent between left (positive) terminal on motor and corresponding terminal of wire harness connector. Set meter in the AMPS position. Connect a jumper wire between right (ground) terminal on motor and corresponding terminal wire harness connector (Fig. 4).
3. Place system temperature control lever in the mid-range position (halfway between COOL and



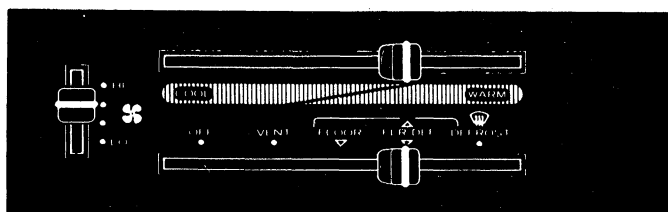
OFF POSITION



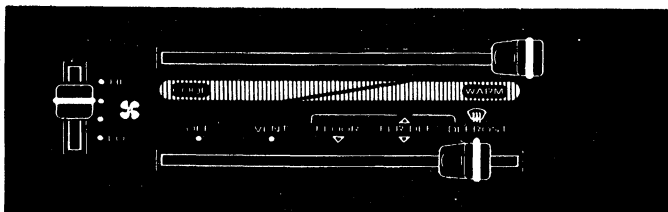
VENT - COOL POSITION



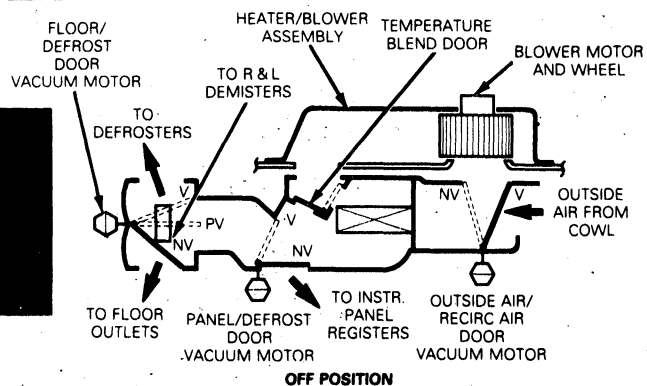
FLOOR - WARM POSITION



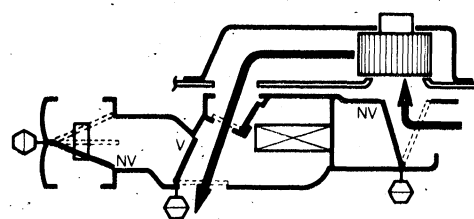
FLOOR/DEFROST - WARM POSITION



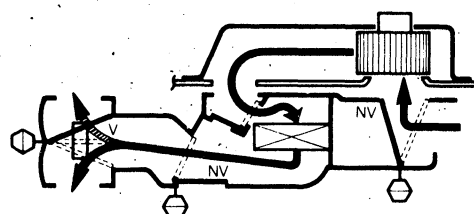
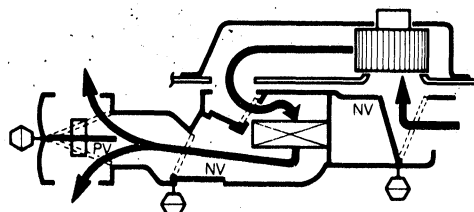
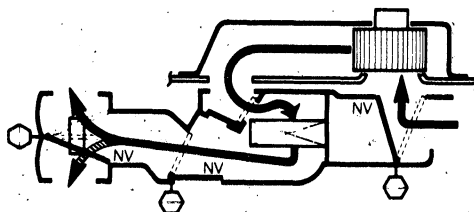
DEFROST - WARM POSITION



OFF POSITION



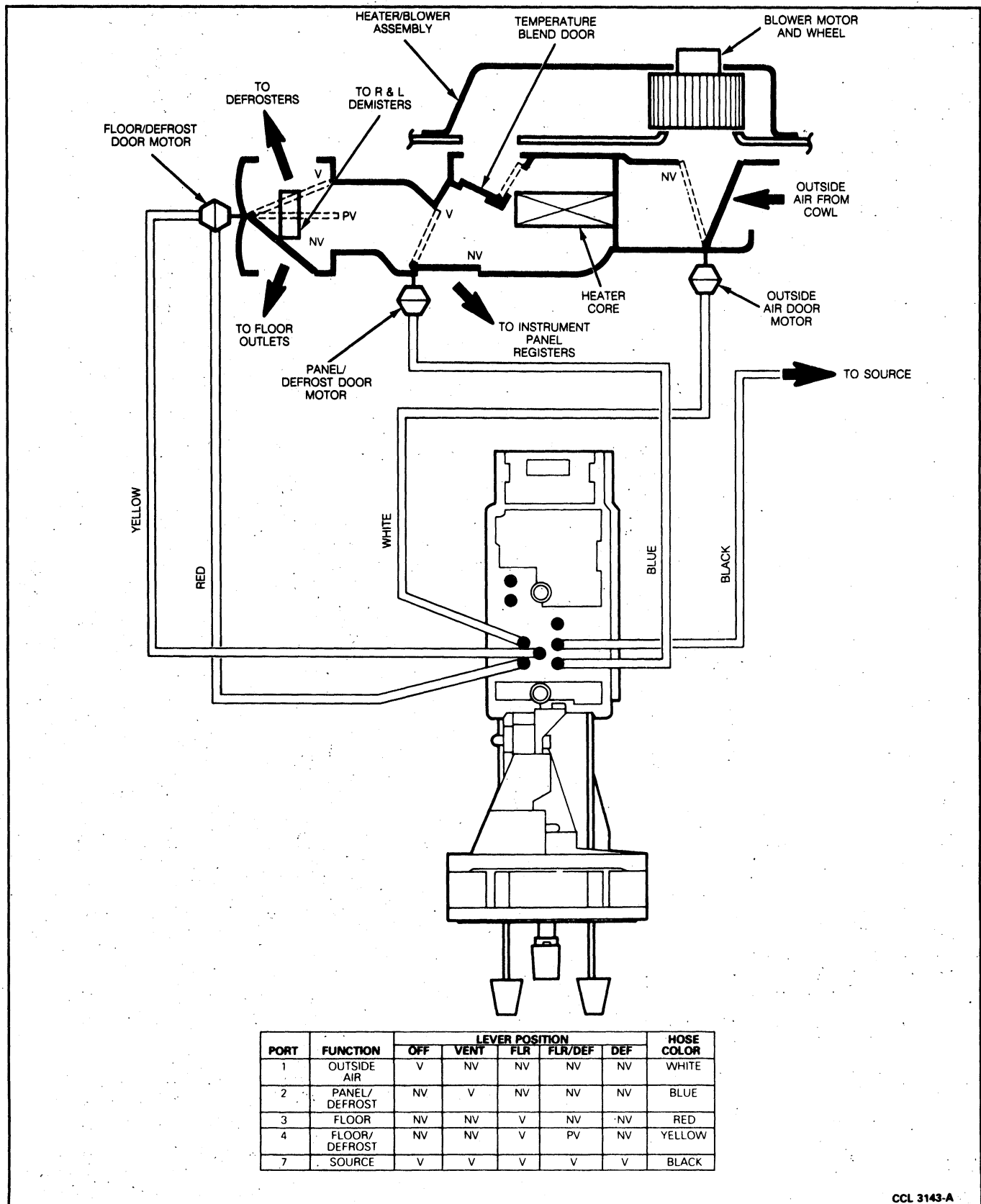
VENT POSITION

FLOOR POSITION  
(BLEED TO DEFROST)FLOOR/DEFROST POSITION  
(EQUAL DISTRIBUTION TO FLOOR & DEFROST)

DEFROST POSITION (BLEED TO FLOOR)

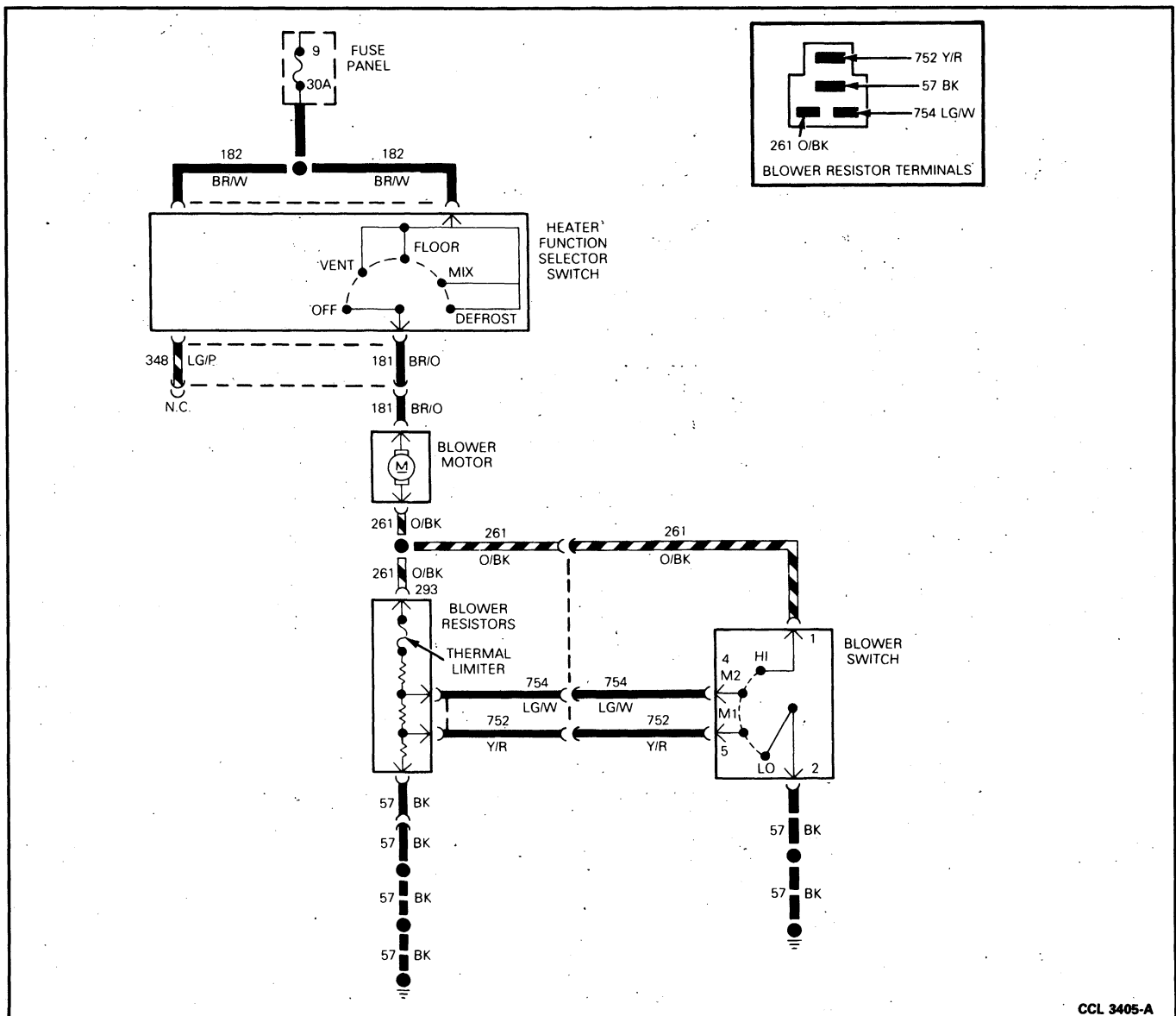
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FIG. 2 Heater-Ventilation System Airflow



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FIG. 3 Vacuum Diagram and Selector Test



CCL 3405-A

FIG. 4 Heater System Electrical Schematic

WARM) and function control lever in PANEL position (air through registers).

4. With battery fully charged, start engine and operate blower in all blower speeds. Record current draw for each blower speed.
5. The current draw for each blower speed should be within limits shown in Specifications.

Digital Volt-Ohm Meter and jumper wire. Connect the harness connector to blower motor.

7. Check blower system for proper operation.

## ADJUSTMENTS

### Temperature Control Cable

The temperature control cable which links the lever in the control assembly with the blend air door cam on the plenum assembly operates mechanically. This cable can be adjusted, if necessary. The procedure is as follows:

To determine the need for adjustment:

1. Move the temperature control lever back and forth between the limits of its travel. Listen for the sound of the blend air door closing before the lever has reached the travel limit.
2. If the sound of the door seating is not heard, it is probable that the cable is either improperly adjusted or disconnected.

NOTE: If the temperature control lever cannot be moved back and forth, the adjustment pin may have been left in the control cam during assembly.

To remove the temperature control can adjustment pin:

1. Disengage glove compartment door by squeezing the side with stop and removing pin retaining check strap from opposite side. Allow door to hang free.
2. Working through glove compartment opening and using a mirror for visibility, remove red assembly pin from control cam with mechanical fingers or a wire with a hook on the end.
3. Check for proper control cable operation.
4. Install glove compartment and door.



To adjust the cable:

1. Disengage glove compartment door by squeezing side with stop and removing pin retaining check strap from opposite side. Allow door to hang free.
2. Working through glove compartment opening, remove cable jacket from metal attaching clip on the top of plenum by depressing clip tab and pulling cable rearward.

NOTE: Cable end should remain attached to door cam and/or crank arm.

3. Set temperature control lever to COOL and hold it firmly.
4. With cable end attached to temperature door cam, push gently on cable jacket to seat blend door (push until resistance is felt). Install cable into clip by pushing cable jacket into clip from top until it snaps into place (Fig. 5).
5. Operate system to check temperature control.

## REMOVAL AND INSTALLATION

### Control Assembly

#### Removal

1. Disconnect battery ground cable(s).
2. Pull the center finish panel away from the instrument panel to gain accessibility to the four screws which attach the control assembly to the instrument panel. (Refer to Section 45-61.)
3. Remove the four screws. Then, pull the control assembly far enough through the opening in the panel to allow disengagement of the electrical connectors for the blower switch and control illumination lamp.
4. Disconnect the vacuum harness connector from the vacuum selector valve on the control assembly.
5. Disconnect the vacuum harness from the plenum assembly connector.

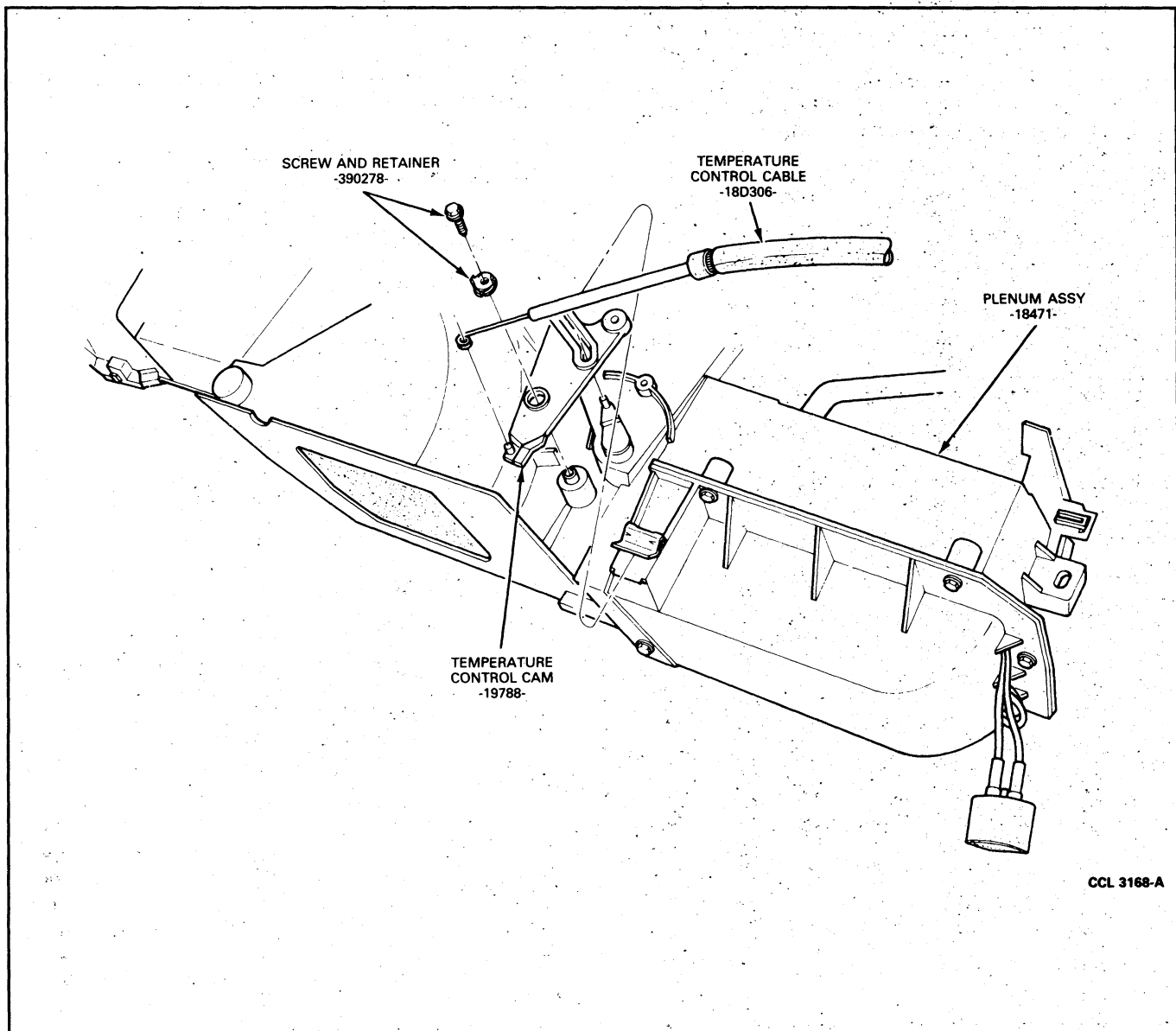


FIG. 5 Temperature (Blend Air Door) Cable Adjustment

6. Using a screwdriver or needlenose pliers, carefully release the temperature control snap-in flag from the underside of the control assembly (Fig. 6).
7. Rotate the control assembly 90 degrees and disconnect the temperature control cable from the temperature control lever.
8. Move the control assembly away from the instrument panel.

#### Installation

1. Pull the temperature control cable through the control assembly opening in the instrument panel for a distance of approximately 203mm (8 inches).
2. Hold the control assembly against the instrument panel with the face of the control directed toward the roof of the vehicle. Attach the temperature cable to its control lever.
3. Rotate the control assembly back to the position it occupies for insertion into its instrument panel opening. Snap the cable flag into the control bracket. Be sure that the flag is firmly seated.
4. Connect the wire harness to the blower switch and control illumination lamp. Attach the vacuum harness to the vacuum selector valve and plenum.
5. Position the control assembly into its instrument panel opening while being careful that the vacuum and electrical harness are properly stowed.
6. Install the finish panel.
7. Connect the battery ground cable(s).
8. Check the system for proper operation.

#### Blower Switch

##### Removal

1. Remove the instrument panel center finish panel as described in Section 45-61.
2. Disconnect battery ground cable(s).
3. Remove control assembly instrument panel as outlined. Do not detach cables.
4. Remove knobs from blower switch by placing a small screwdriver between knob spring retainer

and face of control assembly. Apply pressure to knob spring retainer by pulling on screwdriver and pull knob from switch.

5. Pull control assembly through instrument panel opening far enough to allow removal of blower switch electrical connector.
6. Remove electrical connector from switch by lifting snap-lock retainer with a screwdriver and pulling on the connector.
7. Remove hex-head screw attaching blower switch to control assembly bracket. Remove switch (Fig. 7).

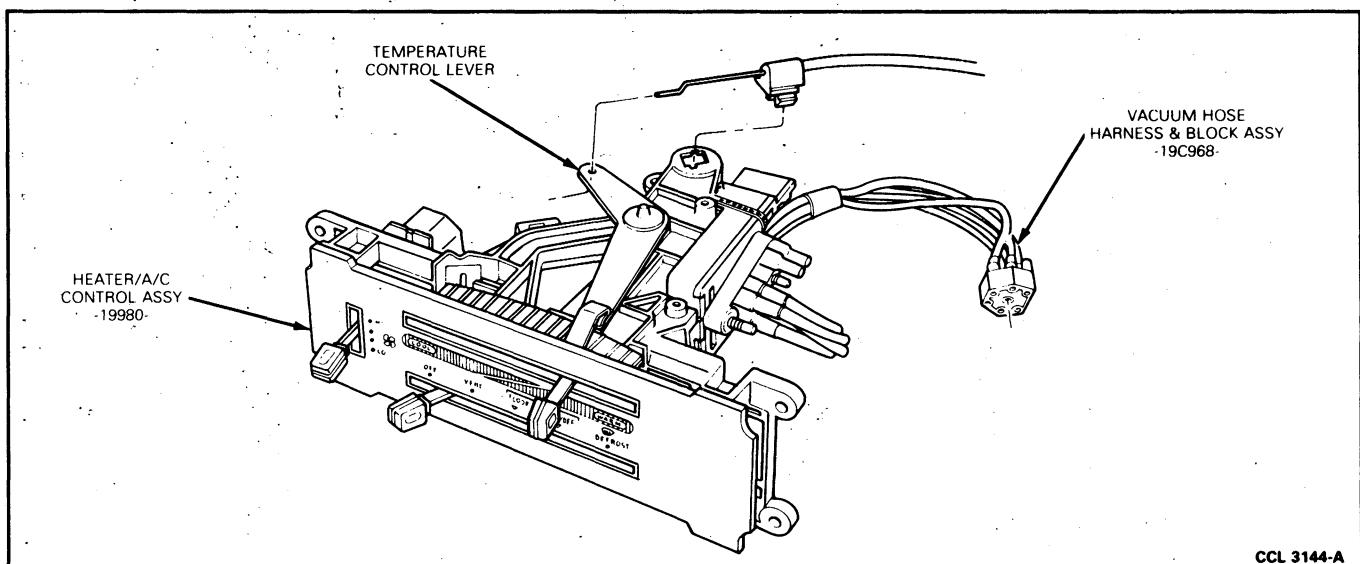
#### Installation

1. Insert the switch lever without its knob through its slotted opening in the control assembly.
2. Install the bracket portion of the switch assembly over the two locating/retaining nibs in the upper surface of the control assembly. Install the switch and bracket attaching screw. (Refer to Fig. 7).
3. Install the switch knob.
4. Attach the electrical connector to the blower switch.
5. Position the control assembly in its instrument panel opening. Then, install its four attaching screws (Fig. 6).
6. Install the instrument panel finish panel. Refer to Section 45-61.
7. Connect the battery ground cable(s).
8. Check the blower switch for proper operation.

#### Vacuum Selector Valve

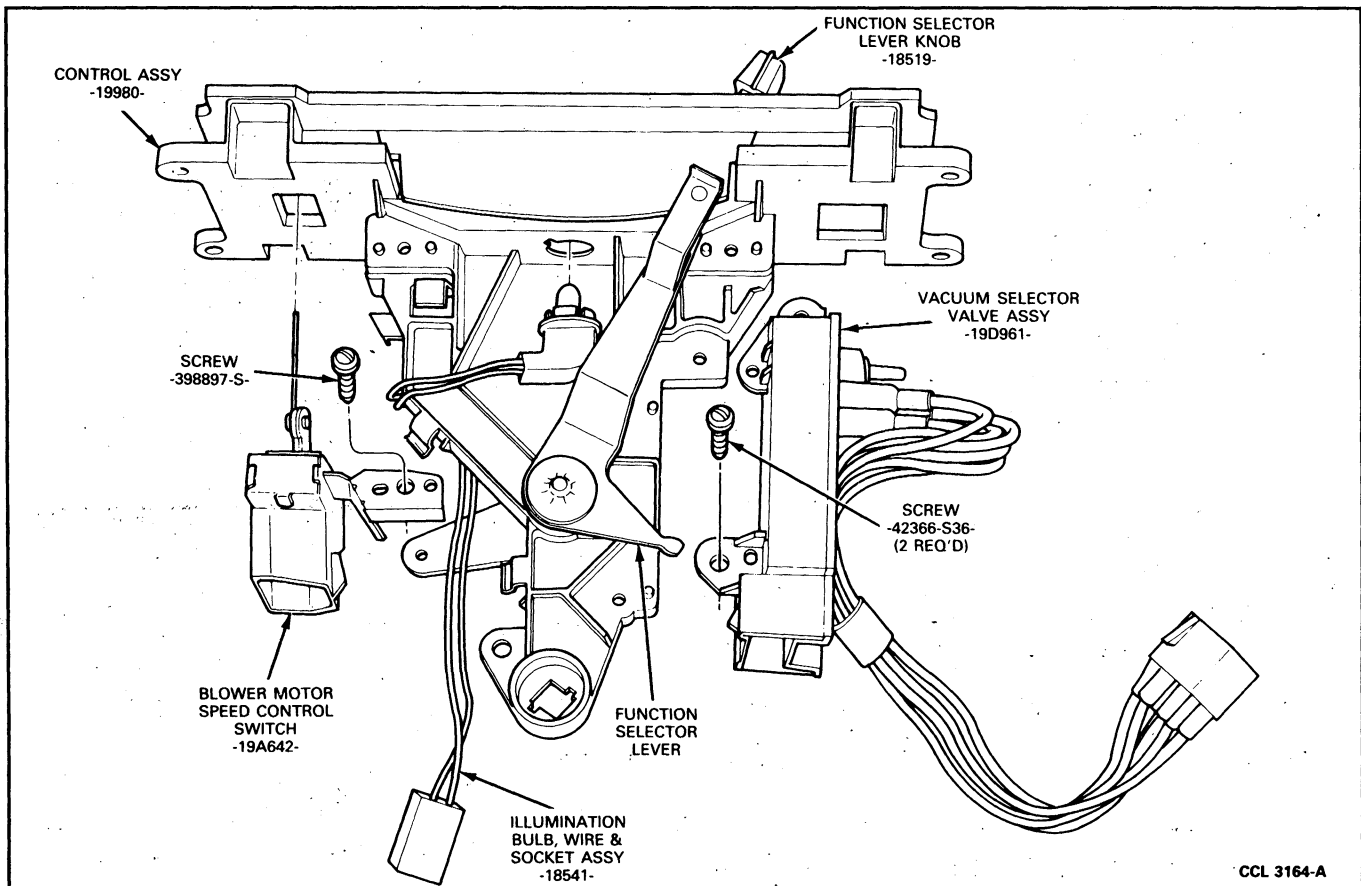
##### Removal

1. Disconnect the battery ground cable(s).
2. Remove the control assembly from the instrument panel as described previously. Do not disconnect the electrical cable.
3. Remove the two screws which attach the vacuum selector valve to the control assembly. Remove the valve (Fig. 8).



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FIG. 6 Heater Control Assembly



**FIG. 7 Heater Control Assembly-Disassembled View**

4. Remove the two nuts which secure the vacuum harness to the selector valve, and remove the harness.

#### Installation

1. Install the vacuum harness on the vacuum selector valve.
2. Position the vacuum selector valve over its mounting location on the control assembly. Align the holes and then install the two attaching screws.
3. Connect the vacuum harness at the plenum. Be certain that the locking tabs are engaged.
4. Position the control assembly in its instrument panel opening. Be sure that the electrical and vacuum harnesses are properly stowed. Install the four attaching screws. Refer to Fig. 6.
5. Connect the battery ground cable(s).
6. Start the engine to provide vacuum. Then, move the function lever to each of its operating positions to verify that vacuum is being distributed properly through the selector valve to the applicable vacuum motor.

#### Temperature Control Cable

##### Removal

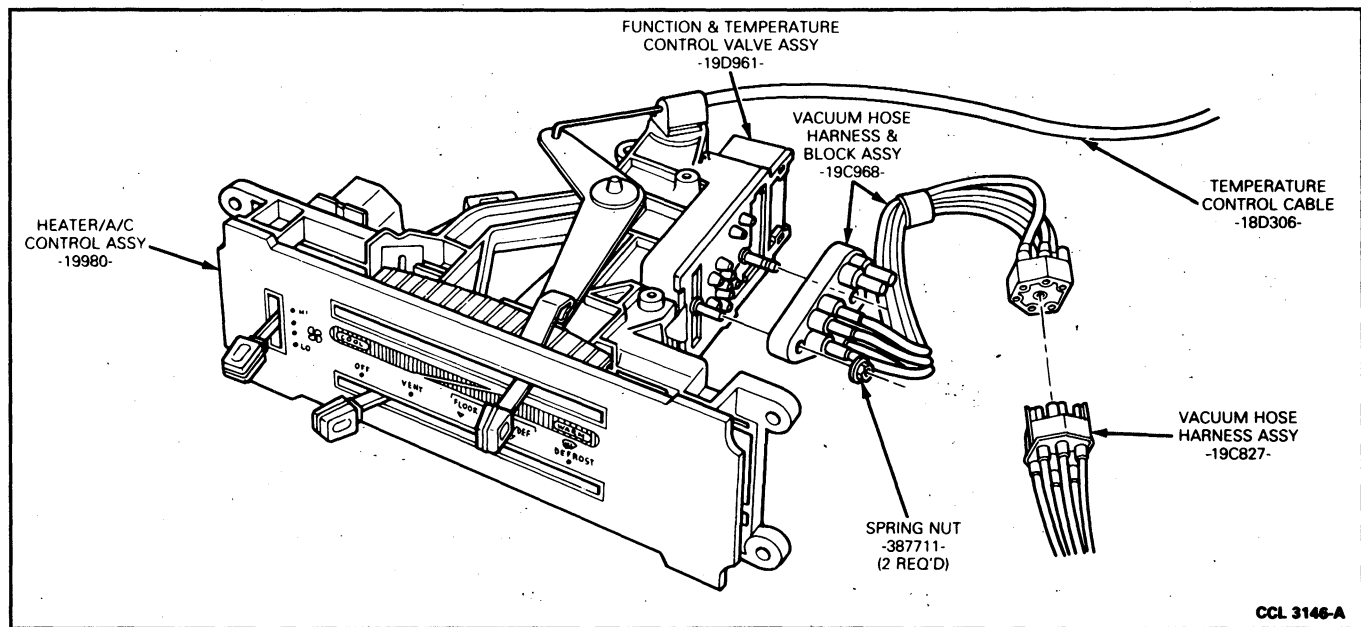
1. Remove the control assembly from the instrument panel as outlined.
2. Disengage glove compartment by squeezing side with stop and removing pin retaining check strap

from outside. Allow glove compartment to hang free.

3. Working through glove compartment, remove temperature control cable housing from clip on top of plenum by depressing clip tab and pulling cable rearward.
4. Working from the bottom of control with a screwdriver or needlenose pliers, carefully release temperature control cable snap-in flag.
5. Rotate control assembly face 90 degrees upward. Disconnect temperature control cable and move the control assembly away from instrument panel.
6. Disconnect temperature control cable from cam on top of the plenum.
7. Pull cables away from instrument panel through control assembly opening.

##### Installation

1. Feed wire loop ends of cable through control assembly opening in instrument panel.
2. Attach wire loop end of cable to the temperature cam assembly on top of plenum. Ensure that the wire loop coil is up and that the cable is routed under cable hold-down on cam assembly.
3. Hold control assembly with its top toward the steering wheel. Attach temperature control cable to temperature control lever. Snap flag into the top of control assembly bracket.
4. Position the control assembly close to the opening in the instrument panel. Working through this



CCL 3146-A

FIG. 8 Vacuum Selector Valve

opening, route the cable so that it will not have kinks or sharp bends anywhere along its course between the control assembly and the cam on the plenum.

5. Adjust cables as outlined.
6. Actuate the temperature control lever and check for proper cable adjustment. Adjust, as necessary.
7. Connect wire and vacuum harness to control assembly and plenum.
8. Install control assembly in instrument panel using four attaching screws.
9. Check system for proper operation.
10. Complete installation of control assembly and glove compartment.

### Temperature Control Cam

1. Disengage glove compartment door by squeezing the side with stop and removing pin retaining check strap from opposite side. Allow door to hang free.
2. Working through glove compartment opening, remove temperature control cam retaining screw and lift cam away from plenum.
3. Move cam as necessary, to disconnect temperature control cable and remove cam from vehicle (Fig. 9).

### Installation

1. Connect temperature control cable to temperature control cam. Ensure that the cable is routed under cable retainer on cam.
2. Position temperature control cam on top of plenum and install retaining screw.
3. Check operation of cam for a full range of temperature control. Adjust temperature control cable as necessary.

### Instrument Panel

Procedure for removal and installation of the instrument panel are covered in Section 45-61.

### Defroster Nozzle

#### Removal

1. Loosen instrument panel and pull it back far enough to gain access to defroster nozzle screws. Refer to Section 45-61 for instrument panel procedures.
2. Remove four screws attaching defroster nozzle to underside of instrument panel (Fig. 10).
3. Remove screw attaching defroster nozzle inlet to center duct.
4. Pull defroster nozzle rearward, clearing mounting tabs. Lift defroster nozzle out.

#### Installation

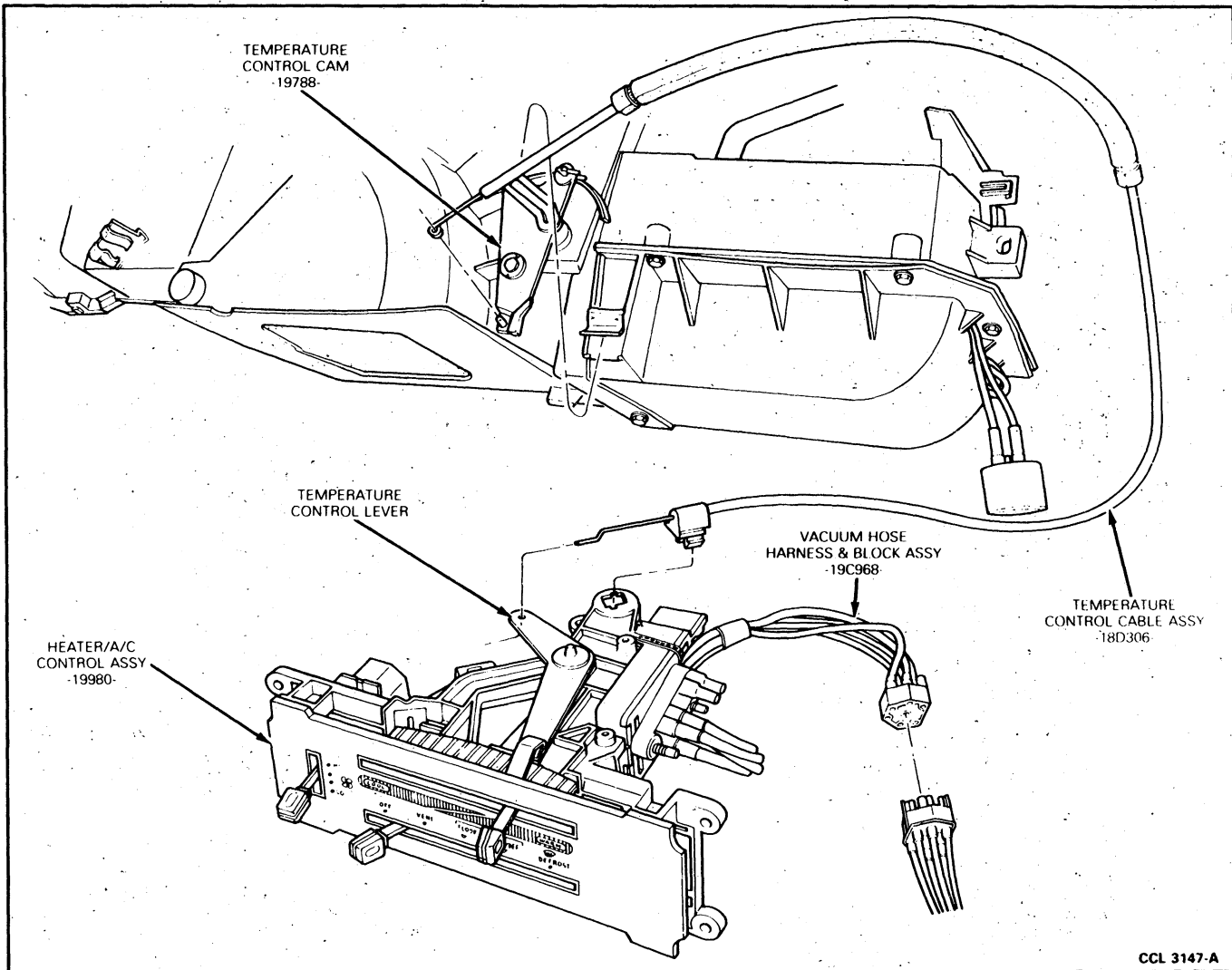
1. Position defroster nozzle in underside of instrument panel and install four retaining screws.
2. Install instrument panel as outlined in Section 45-61.
3. Install defroster inlet retaining screw.

### Demister Nozzles and Hoses

#### Removal and Installation

1. Remove instrument panel, as outlined in Section 45-61.
2. Remove two nuts attaching RH and LH demister nozzles to instrument panel. They are located in opposite corners of the panel. Disconnect flexible hose which slides over the input end of each nozzle (Fig. 11).
3. A connector which slides over a slip joint opening in the center duct receives the opposite end of each of the demister hoses. The hose to the left demister nozzle slides over a neck on upper surface of connector.

The hose on the right demister nozzle slides over a neck on onboard surface of connector. To disconnect a hose, pull it off connector and/or demister nozzle.



**FIG. 9 Temperature Control Cable from Control Assembly to Cam**

4. To install nozzles, hoses, and/or connector, install two attaching screws into each nozzle. Then, slide all removed demister hoses over their attaching locations.
5. Install instrument panel as outlined in Section 45-61.

### Floor Duct

#### Removal and Installation

1. Remove the plastic attaching screw from the bottom side of the plenum.
2. Remove the push nut sleeve from the attaching hole.
3. Disengage the floor duct from the plenum (Fig. 12).
4. To install the duct, position it on the plenum and engage the lugs inside the duct with their mating slots in the plenum. Tilt the duct into place. Then, push it into secure engagement.
5. Start the plastic screw into the push nut sleeve. Then, install them both through the floor duct flange and into the attaching hole in the plenum. Be sure that the attachment is secure.

### Heater Blower Assembly

#### Removal

1. Disconnect battery ground cable.
2. In passenger compartment, remove nut from the bottom of plenum assembly just to the right of heater core access cover.
3. In engine compartment, remove electrical connector from blower motor by pushing on connector tab and pulling connector off motor. Remove connector from blower motor resistor.
4. Remove bolt from heater blower assembly (upper RH side of engine compartment).
5. Remove three attaching nuts from the heater blower assembly (Fig. 13).
6. Pull the heater blower assembly away from the dash panel.

#### Installation

1. Position heater blower assembly to dash panel in engine compartment, taking care to align blower assembly with existing studs.
2. Install three nuts retaining heater blower assembly.

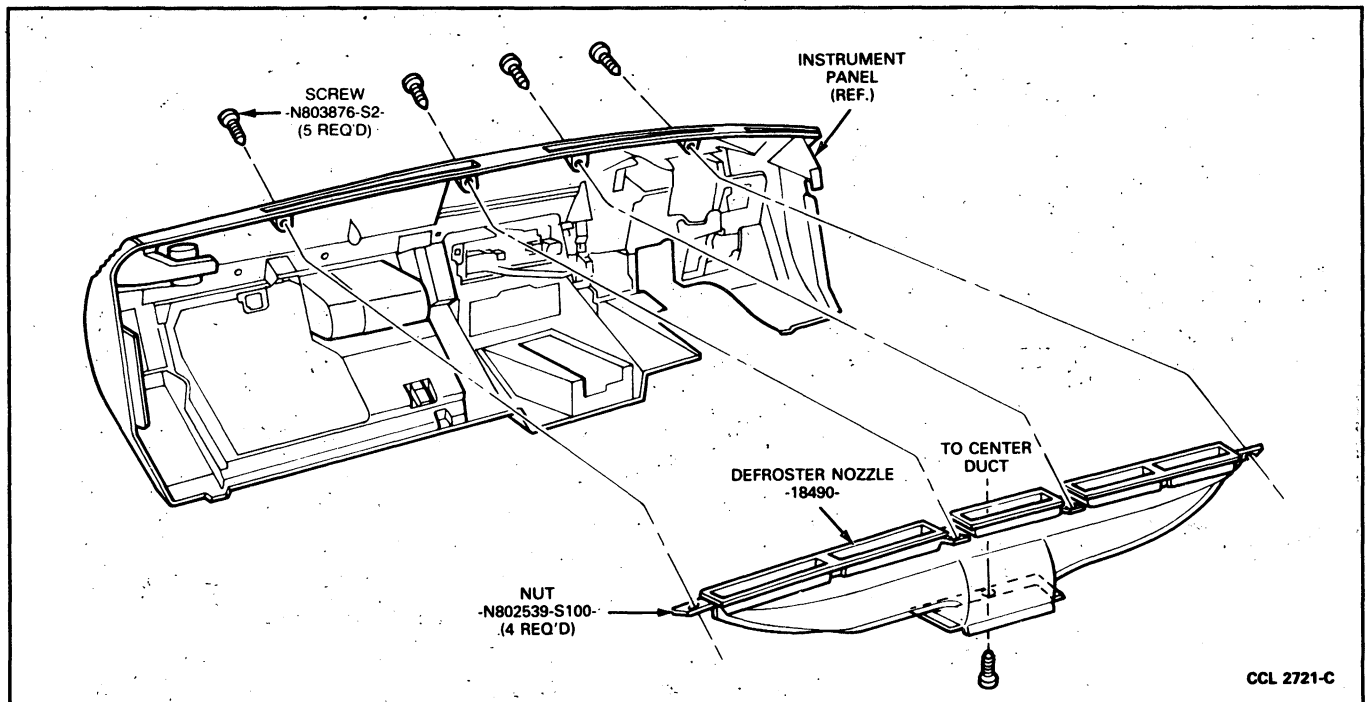


FIG. 10 Defroster Nozzle

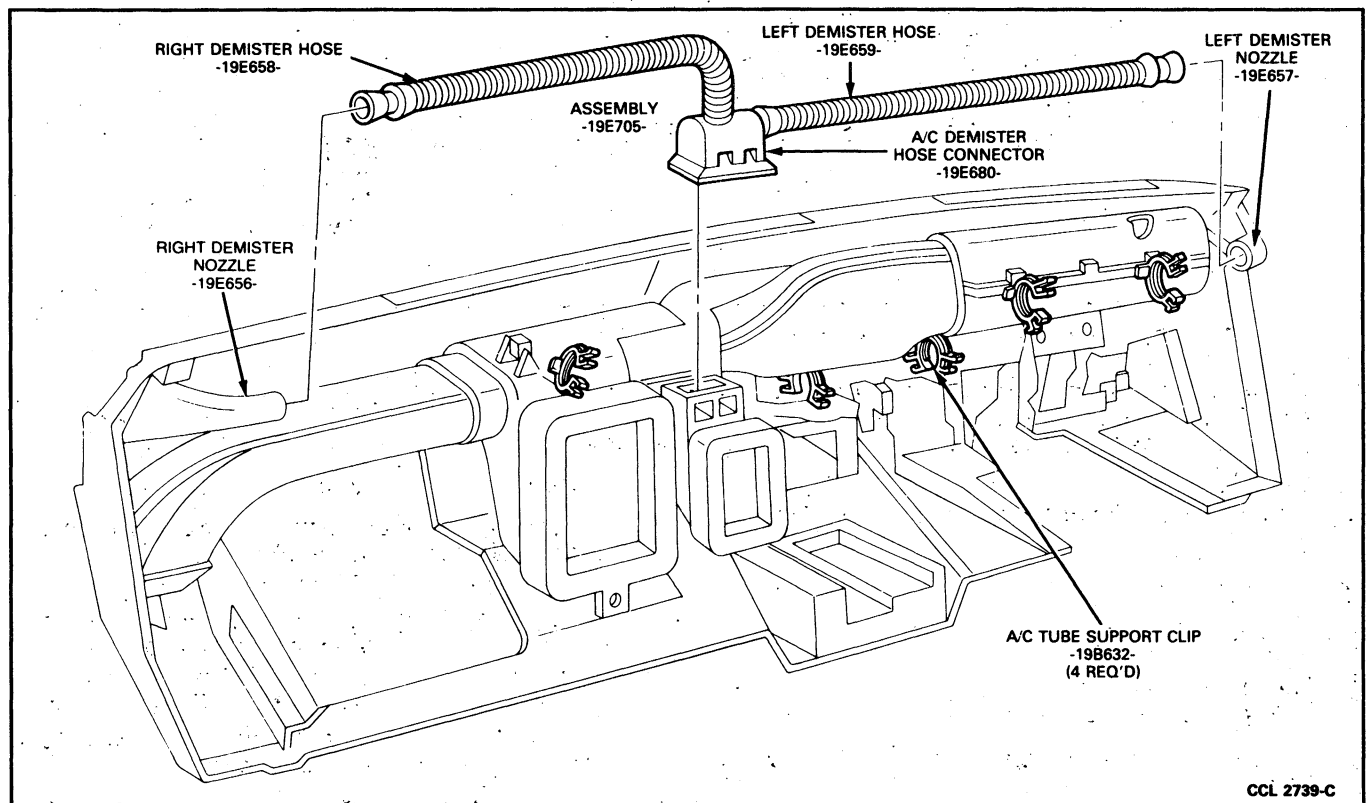


FIG. 11 Demister Nozzles and Hoses

3. Install bolt to the heater blower assembly (upper RH side of engine compartment).
4. Install electrical connectors for the blower motor and resistor.
5. In passenger compartment, install nut on the stud at the bottom center of plenum assembly.
6. Connect battery ground cable(s). Check system for proper operation.

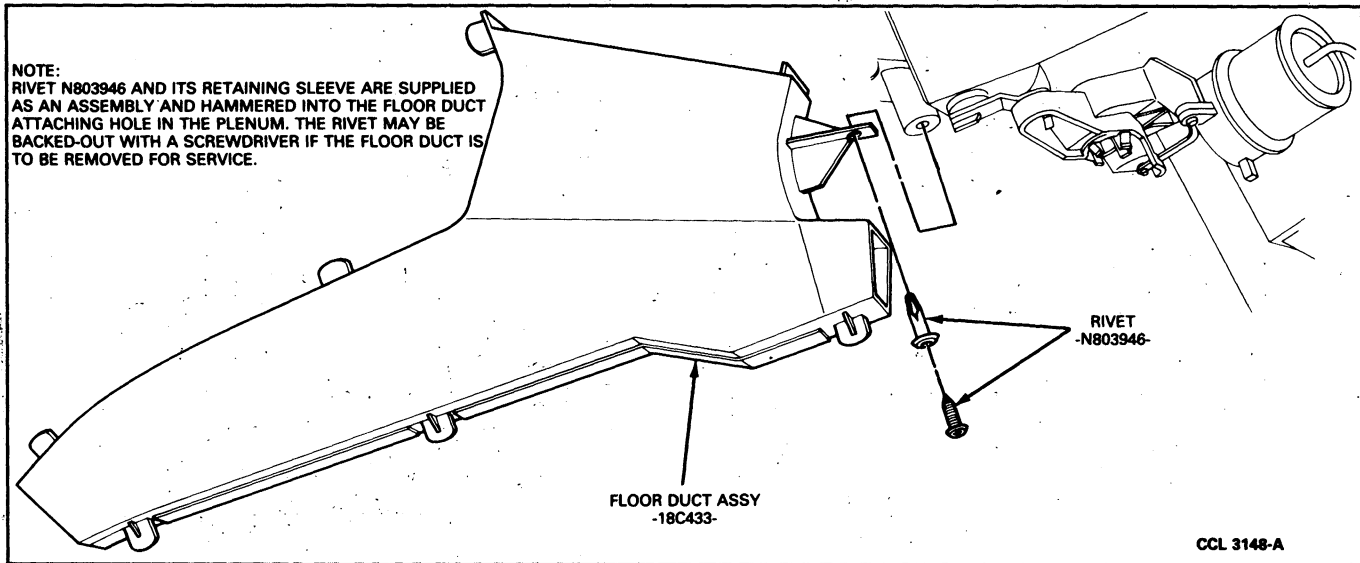


FIG. 12 Floor Duct

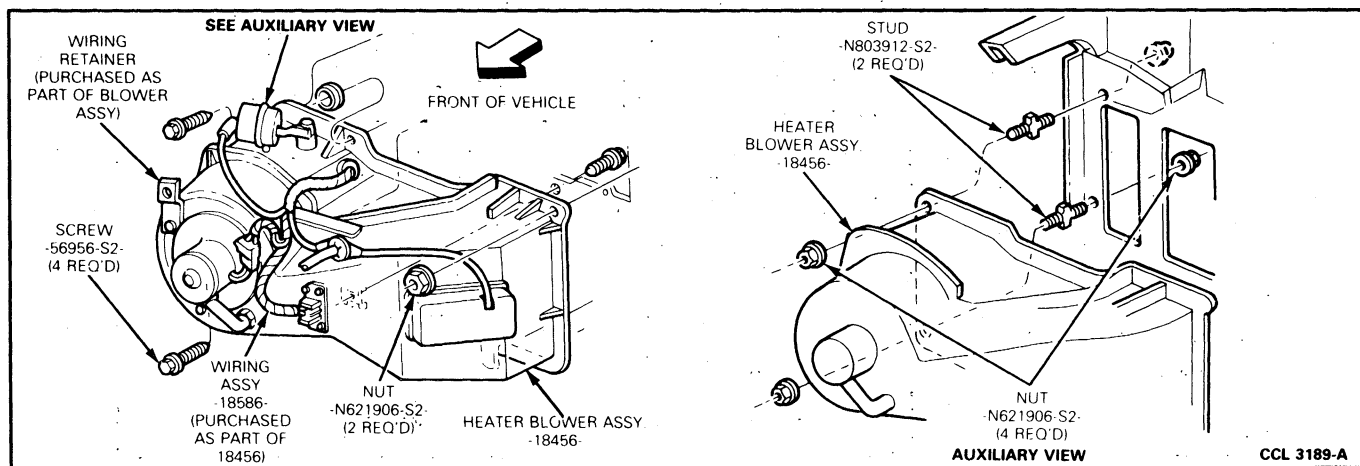


FIG. 13 Heater Blower Assembly

## Heater Plenum Assembly

### Removal

1. Loosen all of the instrument panel retaining screws. Refer to Section 45-61. Move the panel rearward to gain access to the plenum assembly. Remove the glove compartment.
2. Remove the floor air distribution duct from the plenum as described previously.
3. Remove the two nut and one screw which retain the left end of the plenum to the dash panel (Fig. 14).
4. Disconnect the temperature cable and vacuum connections from the control assembly.
5. Disconnect the source vacuum block which is secured to the right side of the heater core cover.
6. Pull the heater case forward to disengage three heater case studs from the dash panel.
7. Lower the plenum assembly from its location under the instrument panel.

Care must be taken to avoid spilling any coolant from the heater core.

NOTE: On some vehicles it may be necessary to remove the instrument panel lower RH attaching screw and the screws attaching the two braces to the lower center area of the instrument panel.

### Installation

1. Position the plenum to dash panel. Install one screw to attach the LH end of plenum to dash panel.
2. Position the heater case to dash panel, making sure that the heater case studs are inserted through holes in the dash panel and plenum flange.
3. Position the instrument panel and tighten its retaining screws.
4. Snap the temperature control cable into the cable mounting bracket on the plenum.
5. Connect the control vacuum and source vacuum.
6. Position the floor duct and install its push pin.
7. Adjust the temperature control cable as described previously.
8. Install the glove compartment.
9. Check the system for proper operation.

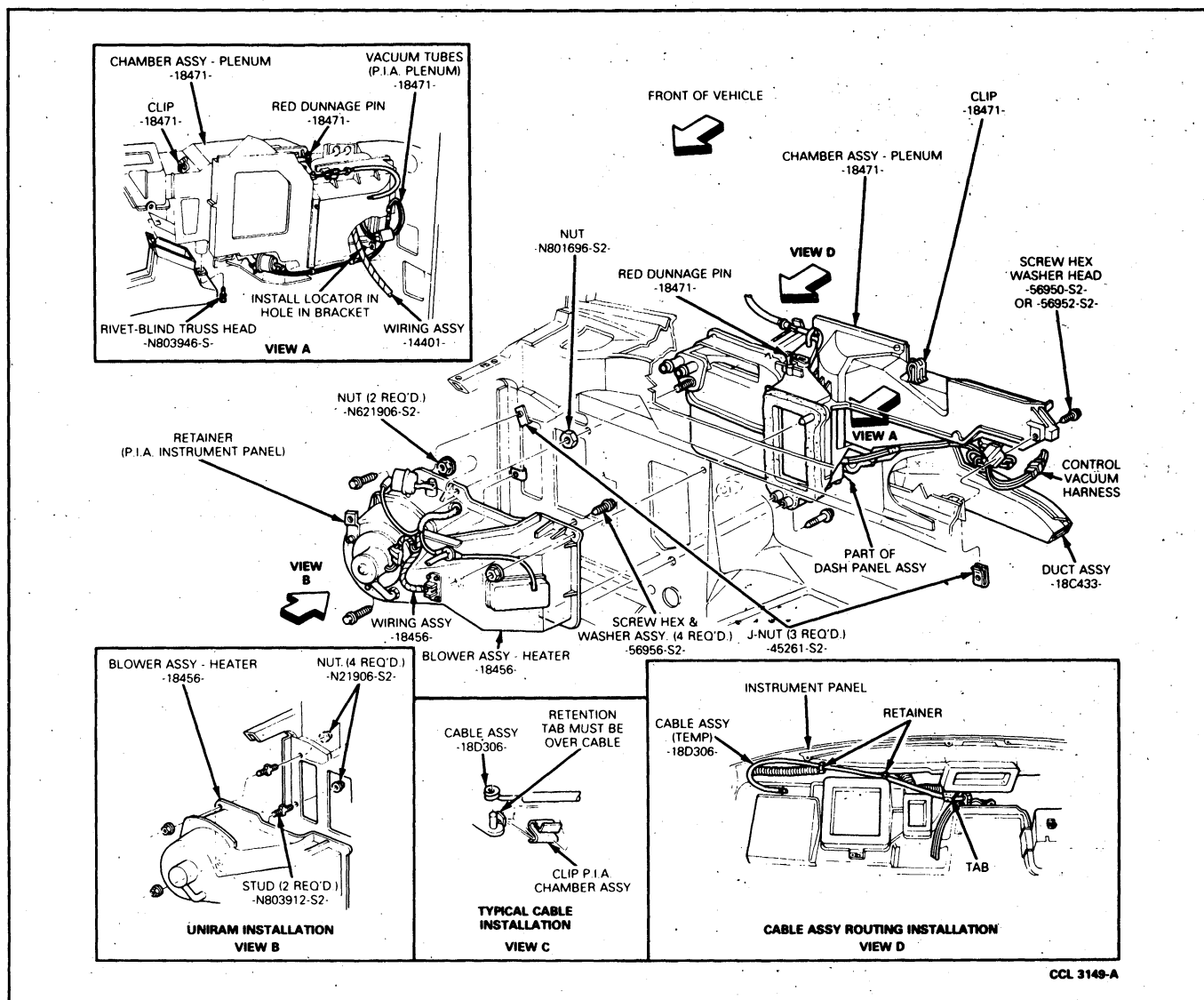


FIG. 14 Heater Blower Motor to Plenum Assembly

### Outside Air Door Vacuum Motor, Crank and/or Door

#### Removal

1. Disconnect the blower motor connector and remove the blower motor.
2. If only the vacuum motor is to be removed, disconnect the two screws which attach the motor to the upper surface of the outside door duct.
3. Pry the motor and arm assembly upward at the arm end to free it from its mounting peg. A retaining flange which is an integral part of the crank, peg, and flange component may partially obstruct the motor arm in its upward movement along the peg. If this retaining flange should break off when forcing the motor arm upward, a 3/16 inch spring nut (Part No. 383358-S) must be used to retain the motor arm when the same or replacement motor is installed. Figure 15 illustrates motor removal in View A and the area in which retainer flange breakage might occur in View B.
4. Look through blower motor opening in the case and use a screwdriver to depress the snap-on door

crank, while pulling up on the door shaft to release the crank from the door (Fig. 16).

5. Remove the door through the blower motor opening.

#### Installation

1. Insert the door through the blower motor opening. Seat the bottom door pivot first, then swing top door pivot into place.
2. Hold door in full outside air position (swing to full-in board position) and snap in crank (Fig. 16).
3. Align the hole in the vacuum motor arm with the peg in the door crank.
4. Slide the arm downward over the peg and along the inner surface of the retaining flange with the arm seats below the base of the flange surface.

**NOTE:** If the flange has been broken off, install the spring nut as described in Step 2 of the Removal procedure.

5. Install the blower motor in housing and connect blower motor electrical harness.



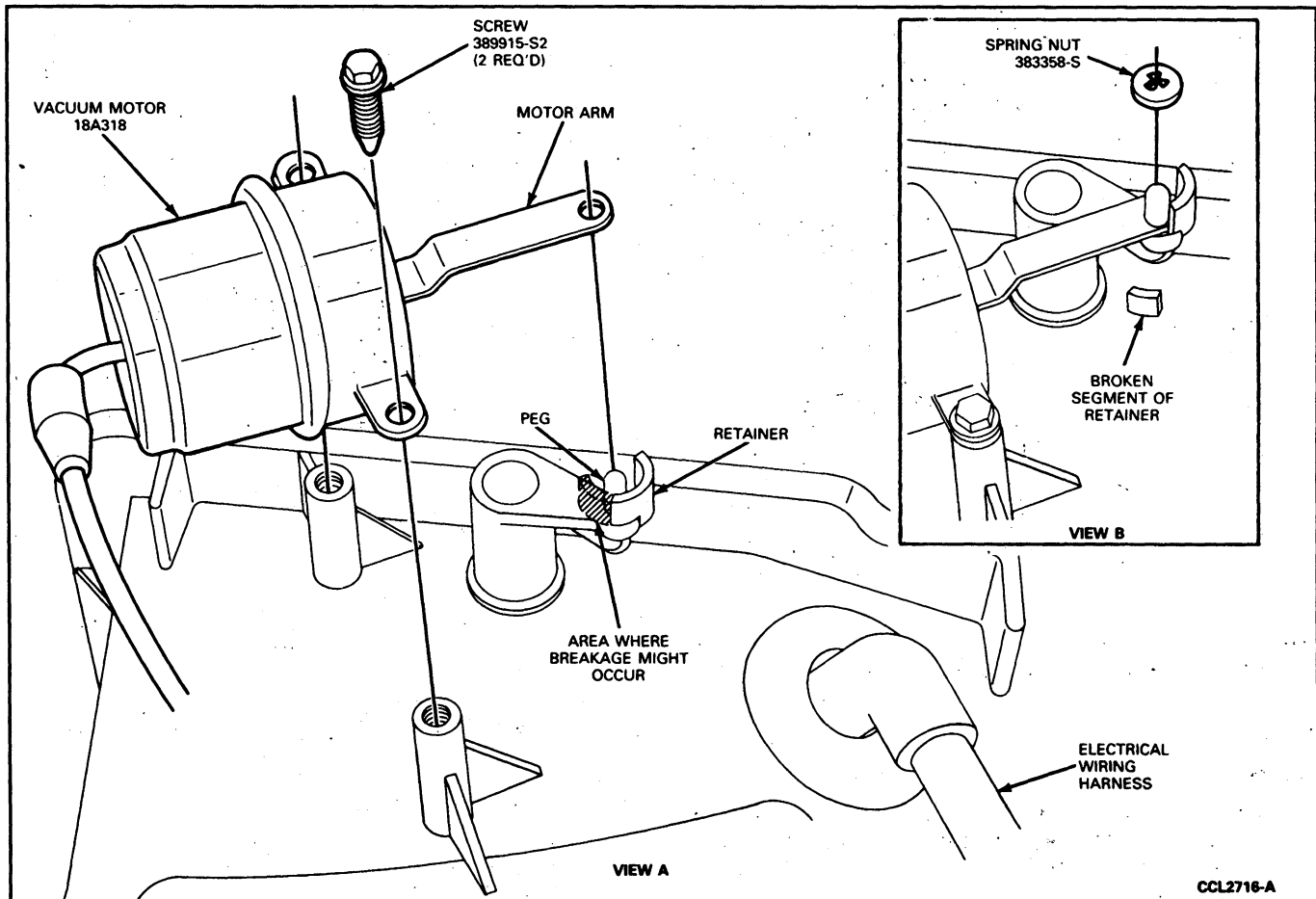


FIG. 15 Outside Air Door Vacuum Motor Removal

### Heater Plenum Doors

The damper doors inside the heater plenum assembly cannot be replaced. As a result, if there is a problem in the floor/defrost or the panel/defrost door, the plenum, including these doors, must be replaced. The plenum must also be replaced if there is damage to the heater case mounting studs which cannot be repaired.

### Heater Plenum Door Vacuum Motors

The vacuum motors for the panel/defrost and floor/defrost damper doors are attached to the underside of the heater plenum assembly. Figure 17 illustrates these motors disassembled from the plenum.

#### Panel/Defrost Door Motor

##### Removal

1. Remove the vacuum hose from the vacuum motor.
2. Remove the two screws which attach the motor and bracket assembly to the plenum.
3. Rotate the assembly so that the slot in the bracket is parallel with the tee-shaped end of the door crank arm. Pull the motor and bracket assembly off the crank arm.

##### Installation

1. Insert the end of the crank arm into the slot in the motor and bracket assembly. Then, rotate the assembly into alignment with the bracket attaching holes in the plenum.

2. Install the two motor and bracket assembly attaching screws.
3. Install the vacuum hose on the motor.
4. Verify that the system functions properly.

#### Floor/Defrost Door Motor

##### Removal

1. Remove the floor duct as described.
2. Disconnect the two vacuum hoses from the vacuum motor.
3. Remove the two screws which secure the motor and bracket assembly to the plenum.
4. Using a small screwdriver, depress the tang on the side of the door operating lever and pull the motor arm out of the lever. Refer to Figure 17.

##### Installation

1. Slide the motor arm into the door lever until the locking tang engages.
2. Attach the two vacuum hoses.
3. Install the two motor and bracket attaching screws.
4. Install the floor duct.
5. Verify that the system functions properly.

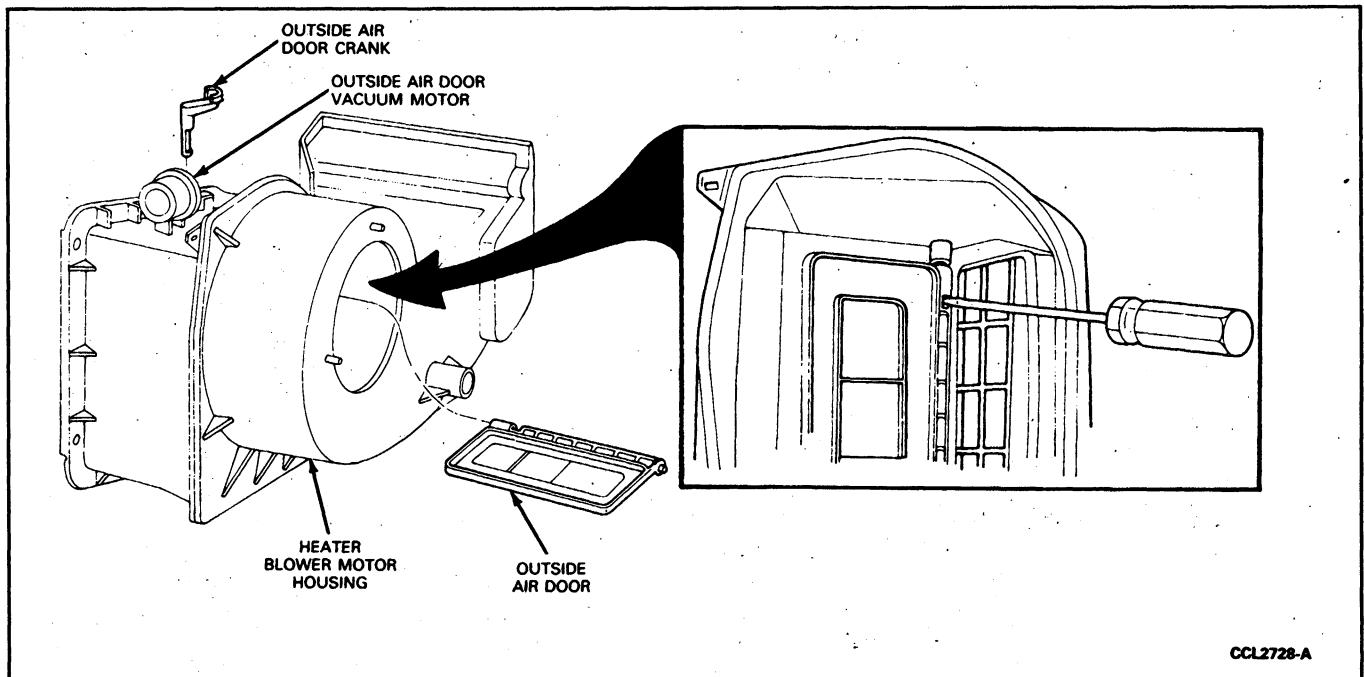


FIG. 16 Removing the Outside Air Door Crank

## Heater Core

### Removal

1. Allow the engine to cool. Then, observing the safety precautions outlined in Section 27-02, Cooling System Service, proceed as follows.
2. Place a thick cloth over the radiator cap.
3. Turn the cap slowly to its first stop to release system pressure.
4. When the pressure has been released, tighten the radiator cap.
5. Disconnect the heater hoses from the heater core tubes, and plug the hoses.
6. For easier access, remove the glove compartment.
7. From inside the passenger compartment, remove the seven screws which attach the heater core access cover to the plenum (Fig. 18).
8. Disconnect the vacuum source. Leave the vacuum harness attached to the cover. Remove the cover.
9. Remove the heater core from the plenum.

### Installation

1. Position the heater core and seal in the plenum assembly.
2. Install the heater core access cover on the plenum assembly and secure it with its seven attaching screws. Be certain that the vacuum harness is not trapped or pinched during the cover installation.
3. Connect the vacuum harness to its source connection.
4. Install heater hoses on the core tubes at dash panel in engine compartment. Do not overtighten the hose clamps.
5. Check coolant level and add coolant as required. Refer to Section 27-02, Cooling System Service.

6. Check system for proper operation and coolant leaks.

## Blower Motor and Wheel

### Removal

1. Disconnect battery ground cable(s).
2. On California vehicles, remove emission module forward of blower motor.
3. Disconnect wire harness connector from blower motor by pushing down on connector tabs and pulling connector off motor. (Refer to Figure 1).
4. Disconnect blower motor cooling tube at blower motor.
5. Remove four screws attaching blower motor and wheel to heater blower assembly.
6. Holding cooling tube aside, pull blower motor and wheel from heater blower assembly and remove it from vehicle (Fig. 19).

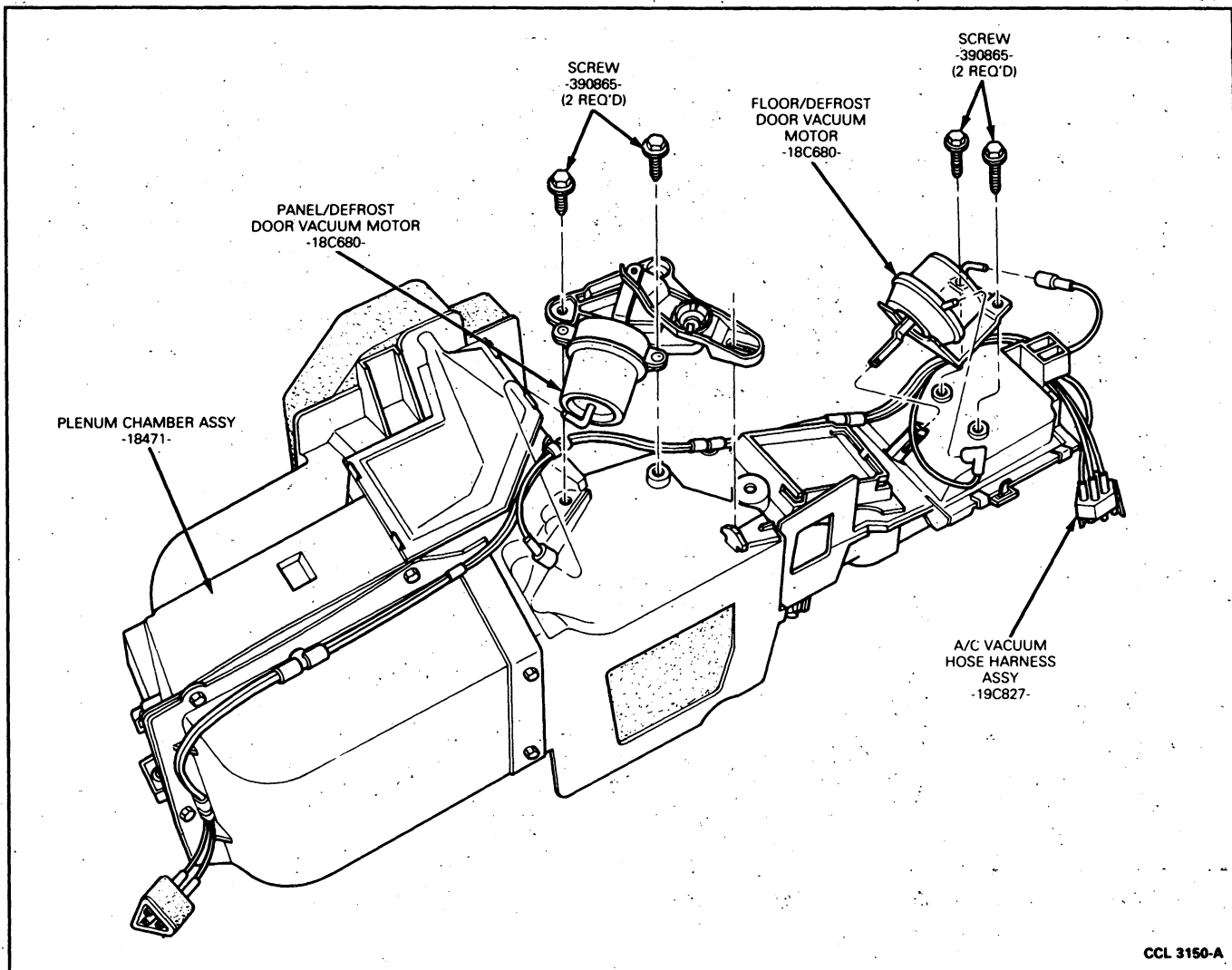
### Installation

1. Install blower wheel onto blower motor shaft.
2. Install hub clamp as shown.
3. Holding cooling tube aside, position blower motor and wheel in heater blower assembly and install three attaching screws.
4. Connect blower motor cooling tube at blower motor.
5. Connect wire harness connector at blower motor (push on).
6. On California vehicles, install emission module forward of blower motor.

## Blower Motor Resistor

### Removal

1. Pry the wire connector from the blower motor resistor.



**FIG. 17 Heater Plenum Door Vacuum Motors**

2. Remove the two screws which attach the resistor assembly to the heater blower assembly (Fig. 12).

#### Installation

1. Position resistor assembly on heater blower assembly.
2. Install two resistor attaching screws and tighten them securely.
3. Connect wire connector to resistor terminals.
4. Check blower for proper operation in all blower speeds.

#### Heater Hoses

##### Removal and Installation

Figures 21 through 24 illustrate the heater hose installations on the 4.9L (300 CID), 5.0L (302 CID), 5.8L (351 CID), 7.3L (447 CID), and 7.5L (460 CID) engines. The following procedure applies to each of the installations.

1. Drain the coolant from the cooling system.
2. Loosen the hose clamps and remove the hoses from the vehicle.
3. Cut a length of heater hose from bulk stock which is the same length as that of the hose which has been removed.

**NOTE:** The 4.9L engine is equipped with performed hoses. As a result, hoses made from bulk stock cannot be used.

4. Route the hoses as shown in the applicable illustration (Figs. 21 through 25).
5. Install the hoses on their fittings and tighten the attaching to 1.8-2.5 N.m (16-22 in-lb).
6. Fill and bleed the cooling system. (Refer to Section 27-02, Cooling System Service.)
7. Check for coolant leaks and proper operation of the system.

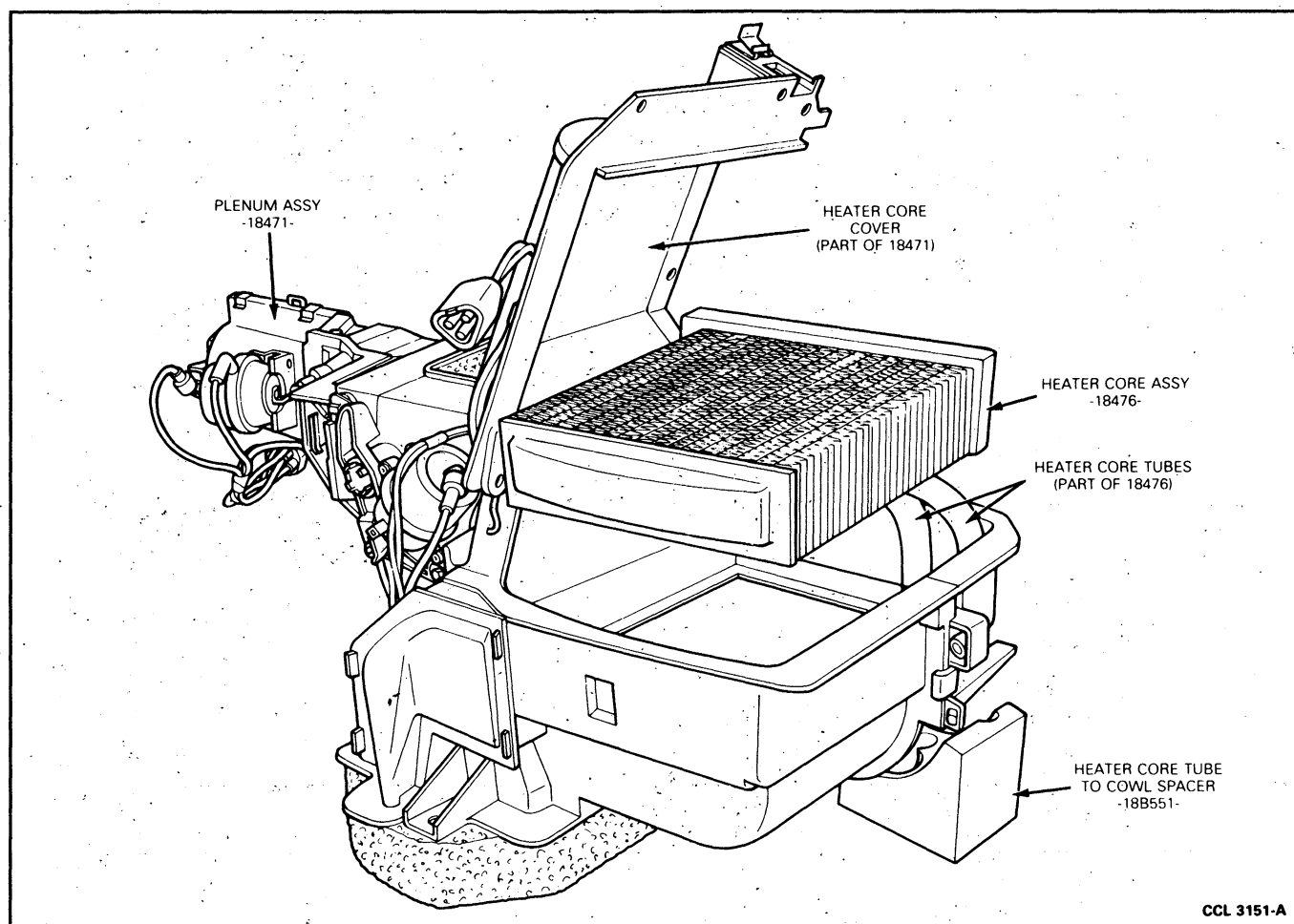


FIG. 18 Heater Core Access Cover and Core Removal

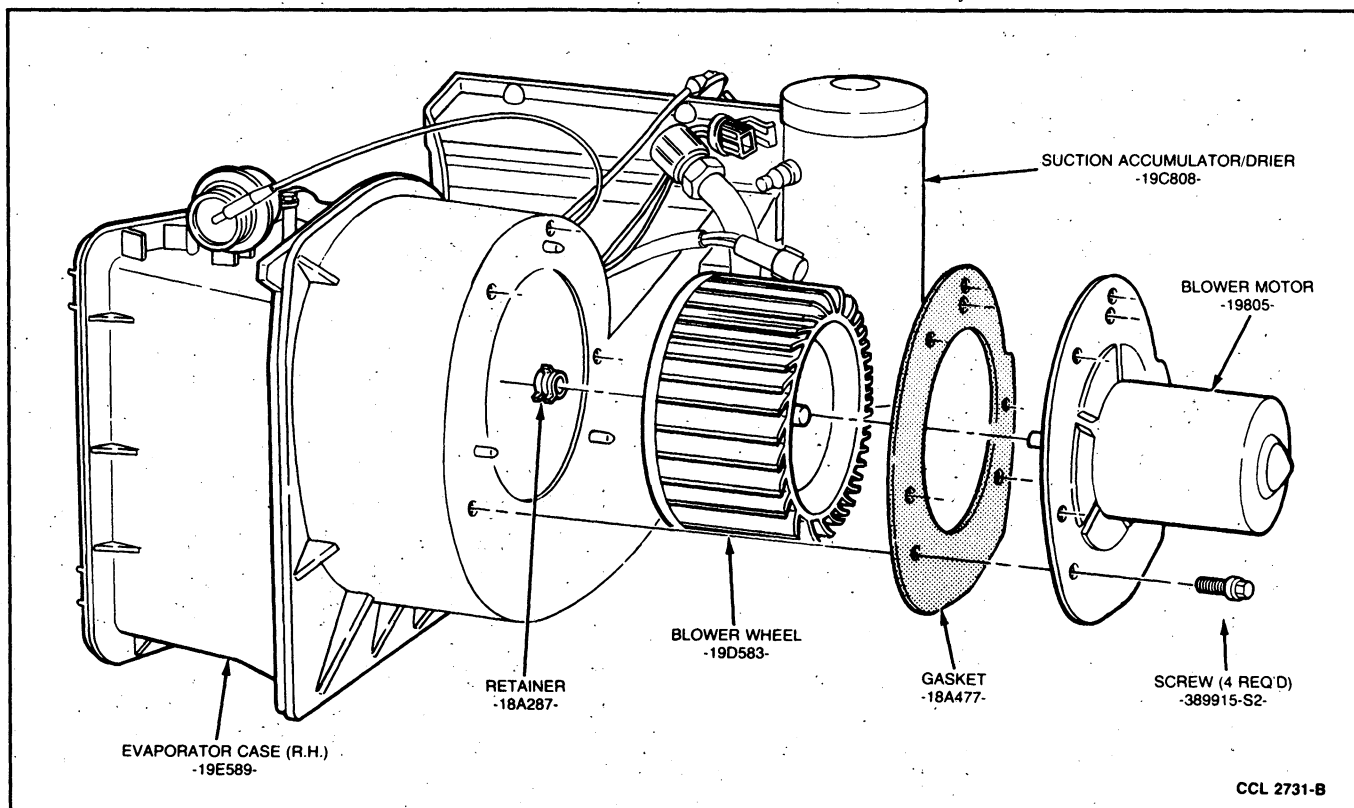


FIG. 19 Blower Motor and Wheel Removal

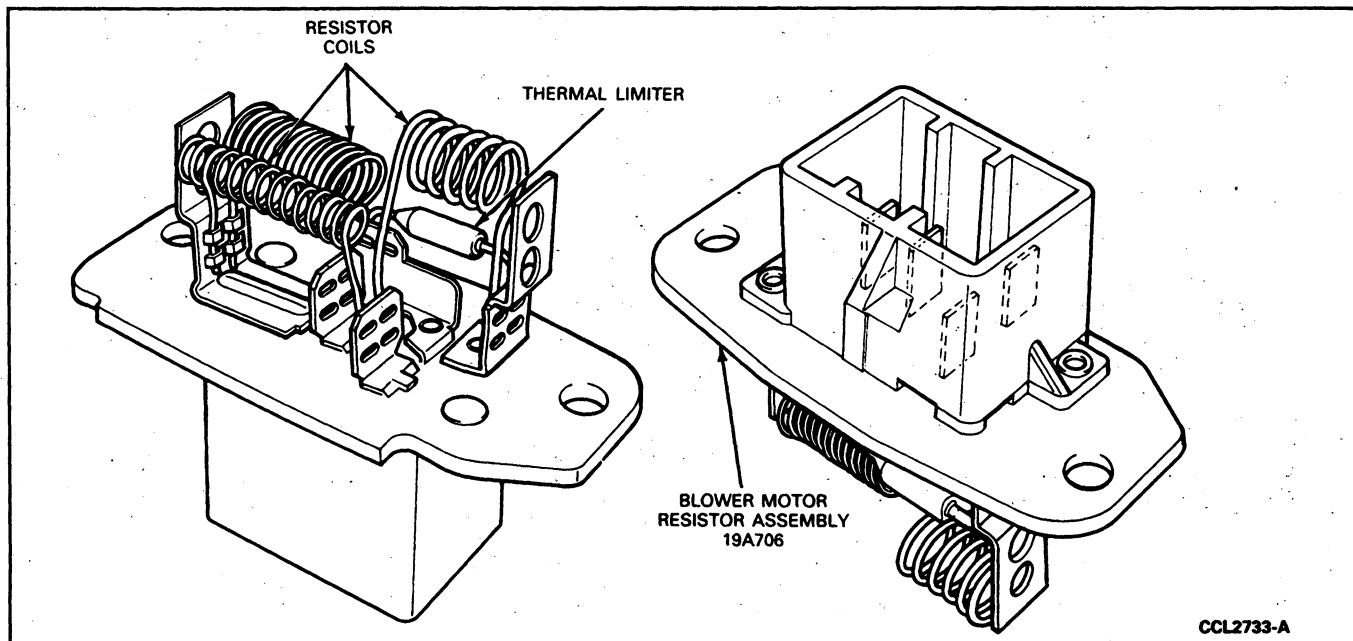


FIG. 20 Blower Motor Resistor

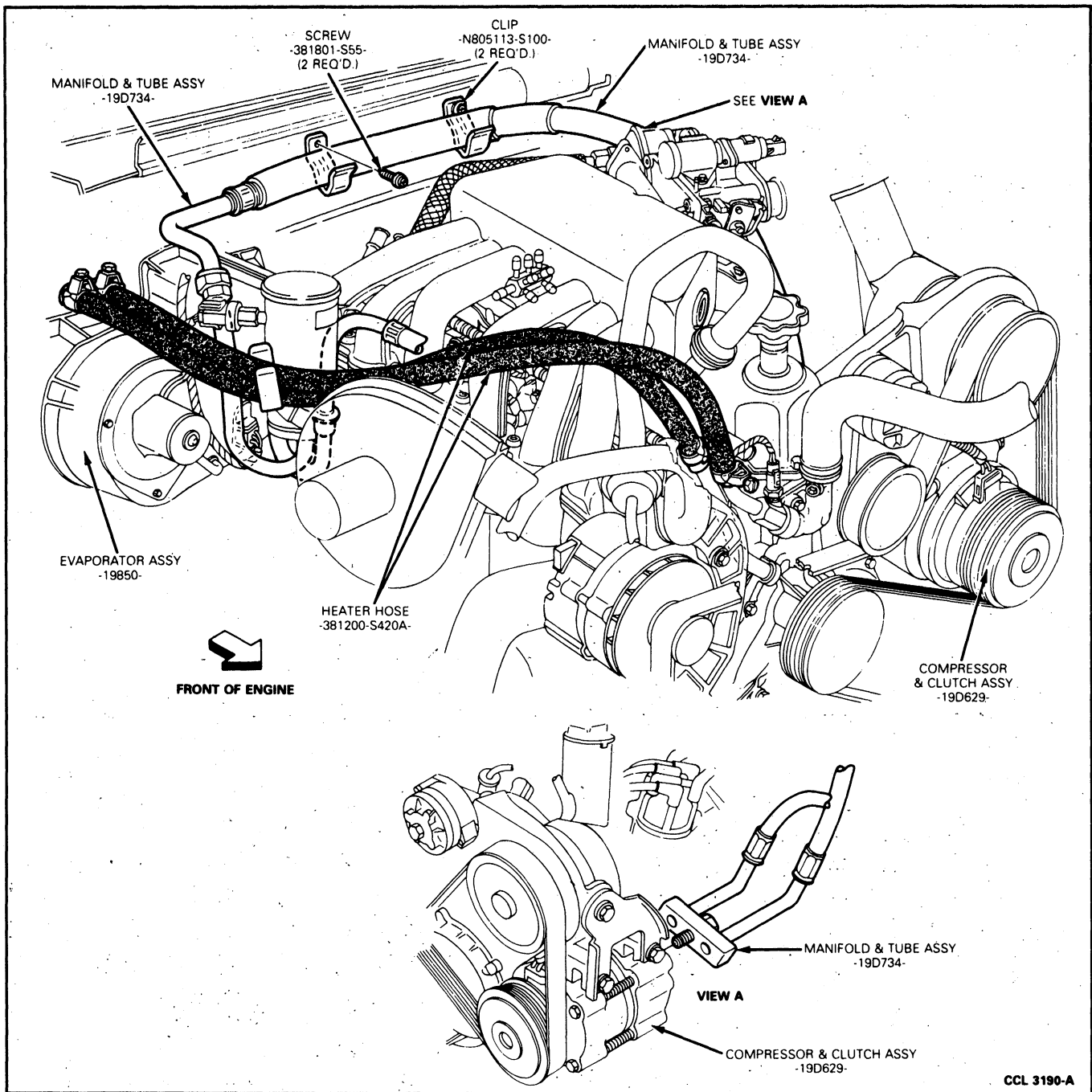


FIG. 21 Heater Hose Installation—4.5L (300 CID) EFI Engine

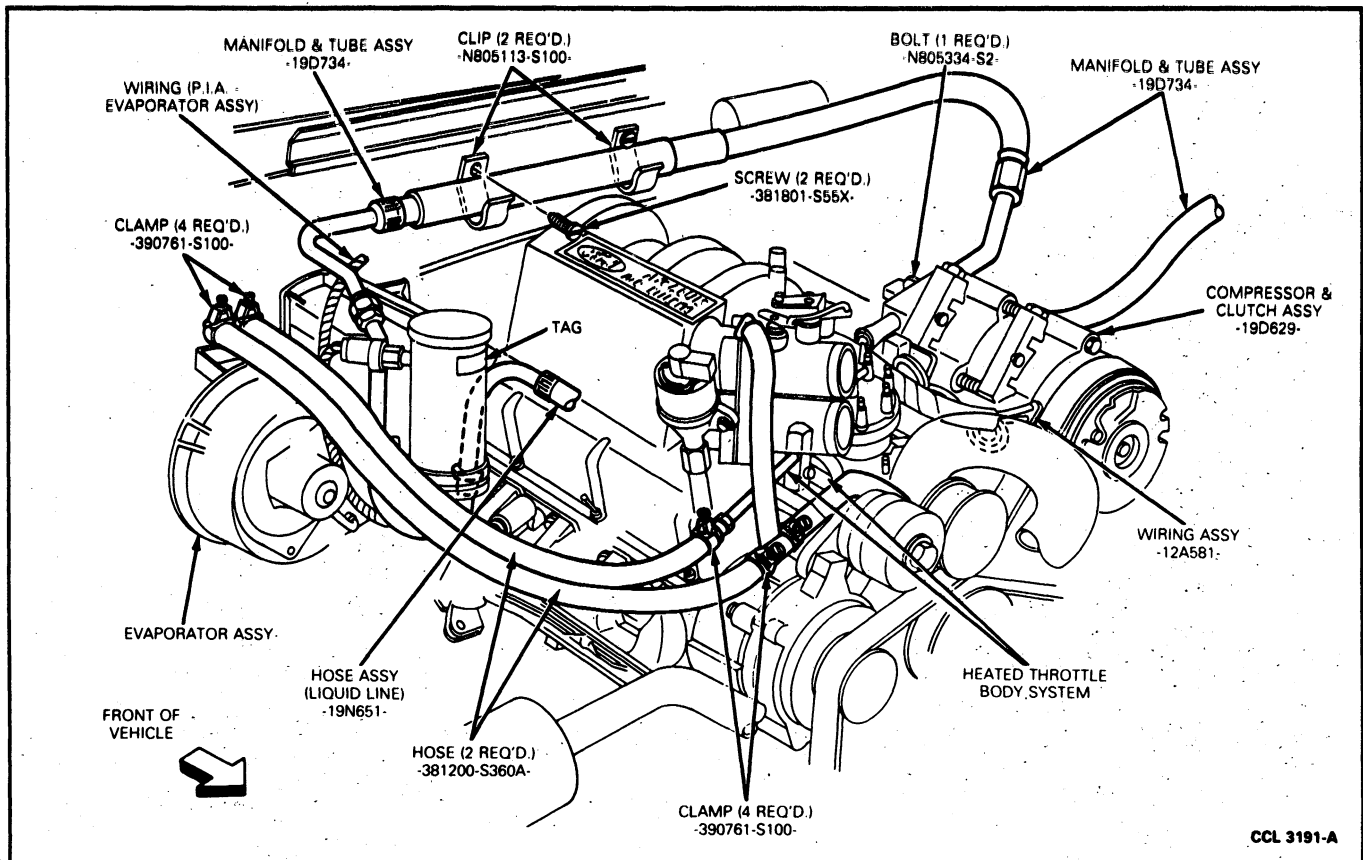
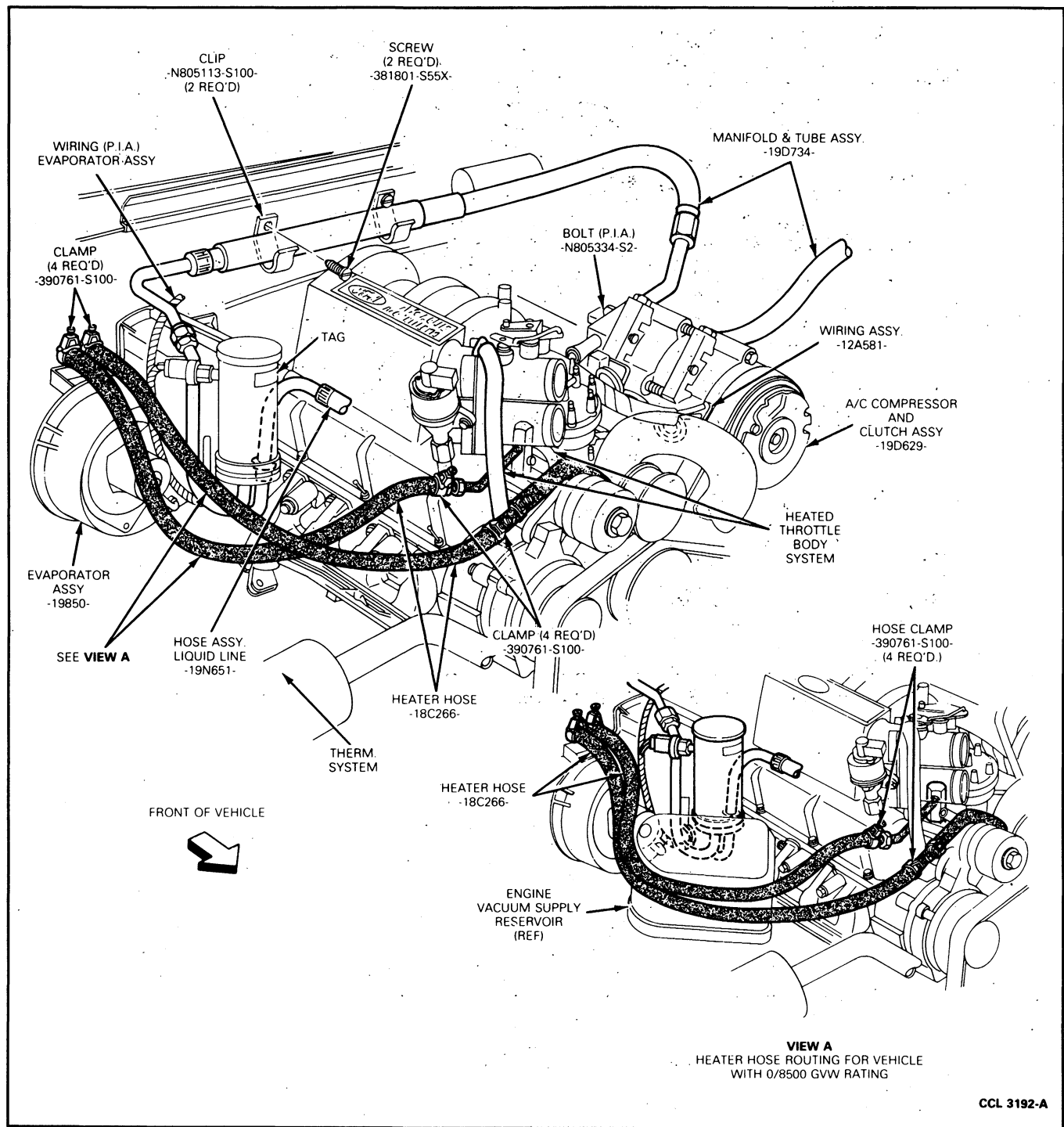


FIG. 22 Heater Hose Installation—5.0L (302 CID) EFI Engine



**FIG. 23 Heater Hose Installation—5.8L (351 CID) EFI (V-8) Engine**



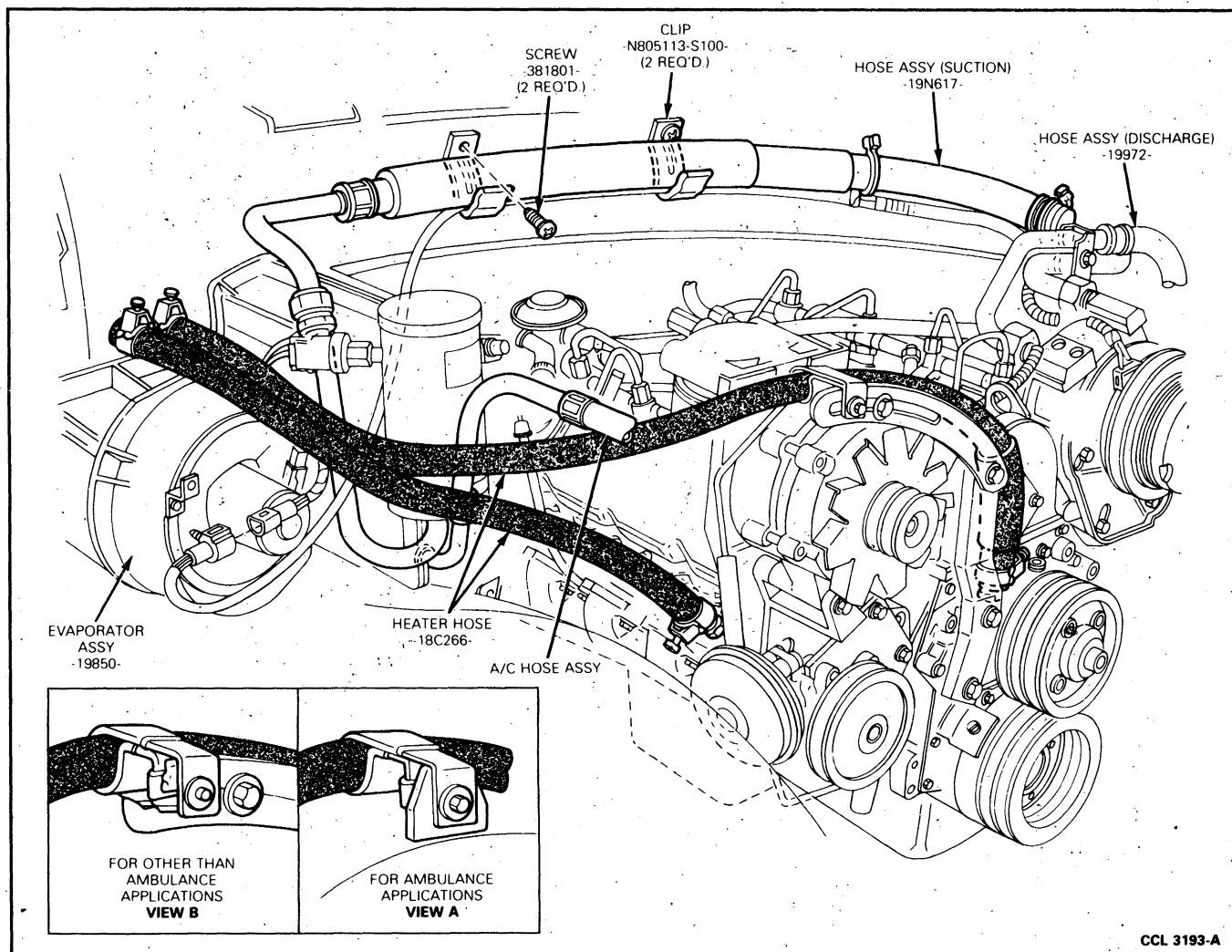


FIG. 24 Heater Hose Installation—7.3L (447 CID) Diesel Engine

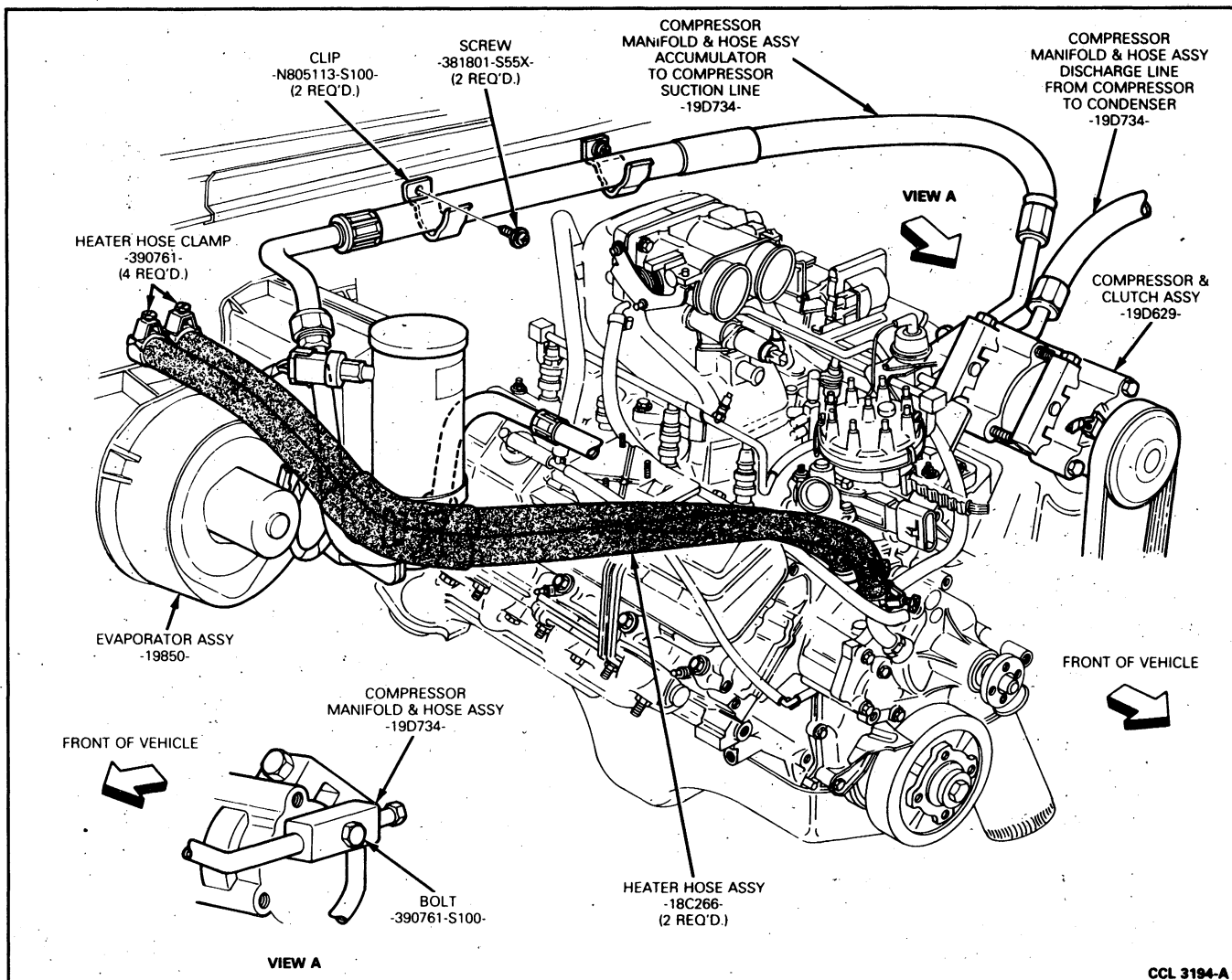


FIG. 25 Heater Hose Installation—7.5L (460 CID) Engine

**SPECIFICATIONS****ELECTRICAL**

System Protection	30 Amp Mini-Fuse (Light Green)		
Blower Circuit	in Panel F-14 (D9ZB-14A094-GA)		
Blower Motor Current Draw		Amps	Volts
Switch Setting			
Off		0	0
Low		4	5
Medium		6	8
High		9	12
Illumination Control Assembly	One ICP-161 Bulb		

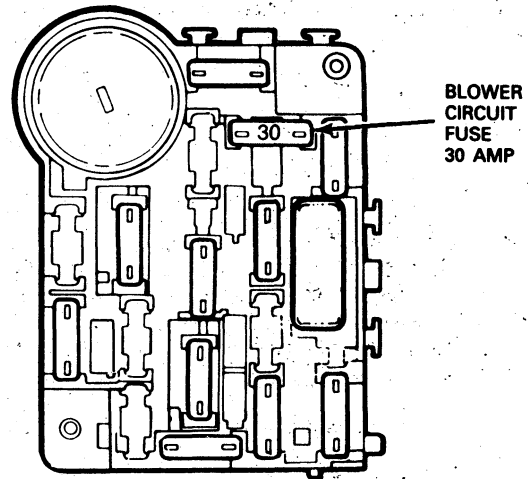
**TORQUE SPECIFICATIONS**

Heater Hose Clamps	1.46-2.03 N·m (13-18 In-Lb)
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**ROTUNDA EQUIPMENT**

Model	Description
007-00001	Digital Volt-Ohm Meter

CN6078-1B



The fuse panel is located on the dash panel in passenger compartment left of steering column.

CL3513-2C

# SECTION 36-30 Air Conditioning General Service

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>DESCRIPTION AND OPERATION (Cont'd)</b>	
Charging the System .....	36-30-6	Heat Transfer .....	36-30-1
Discharge the System .....	36-30-6	Latent Heat of Vaporization .....	36-30-1
Evacuating the System .....	36-30-6	<b>DIAGNOSIS AND TESTING</b>	
Mini-Tube Vacuum Hose .....	36-30-7	Tee Adapter Tool .....	36-30-5
<b>DESCRIPTION AND OPERATION</b>		<b>SPECIFICATIONS</b> .....	36-30-20
Air Conditioner Components .....	36-30-1	<b>VEHICLE APPLICATION</b> .....	36-30-1
Basic Principles .....	36-30-1		

## VEHICLE APPLICATION

All E150-E350, F150-F350, F-Super Duty and Bronco Models.

## DESCRIPTION AND OPERATION

This Section gives the basic principles and service procedures that apply to all Ford Light Truck air conditioning systems. Each of the following Sections (beginning with Section 36-61) covers only those procedures that are peculiar to the indicated vehicle system. **Reference both to this Section and to the Section covering the pertinent vehicle line is necessary for complete coverage of any given system.**

### Basic Principles

Air conditioning is the cooling or refrigeration of the air in the passenger compartment. Refrigeration is accomplished by making practical use of three laws of nature. These laws of nature and their practical application are outlined in the following paragraphs. Basic A/C systems are shown in Fig. 1.

### Heat Transfer

**If two substances of different temperature are placed near each other, the heat in the warmer substance will always travel to the colder substance until both are of equal temperature.** For example, a cake of ice in an ice box does not communicate its coldness to the bottle of milk standing nearby. Rather, the heat in the warm milk automatically flows into the ice.

To determine the amount of heat that transfers from one substance to another, science uses the British Thermal Unit or BTU. One BTU is the amount of heat required to raise the temperature of one pound of water 0.55°C (1°F). For example, to raise the temperature of one pound of water from 0°C to 100°C (32°F to 212°F), one BTU of heat must be added for 0.55°C (1°F) rise in temperature or a total of 180 BTUs of heat. Conversely, in order to lower the temperature of one pound of water from 100°C to 0°C (212°F to 32°F), 180 BTUs of heat must be removed from the water.

### Latent Heat of Vaporization

**When a liquid boils (changes to a gas) it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (changes**

**back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.**

For example, place one pound of water at 0°C (32°F) in a container over a flame. With each BTU of heat that the water absorbs from the flame, its temperature rises 0.55°C (1°F). Thus, after it has absorbed 180 BTUs of heat, the water reaches a temperature of 100°C (212°F). Even though the flame continues to give its heat to the water, the temperature of the water remains at 100°C (212°F). The water, however, starts to boil or change from the liquid to the gaseous state. It continues to boil until the water has passed off into the atmosphere as vapor. If this vapor were checked with a thermometer, it also would show a temperature of 100°C (212°F). In other words, there was a rise of only 100°C (212°F) (from 0°C to 100°C or 32°F to 212°F) in the water and vapor temperature even though the flame applied many more than 180 BTUs of heat. In this case, the heat is absorbed by the liquid in the process of boiling and disappears in the vapor. If the vapor were brought in contact with cool air, the hidden heat would flow into the cooler air as the vapor condensed back to water. Scientists refer to this natural law as the latent (hidden) heat of vaporization.

Water has a latent heat of vaporization of 970 BTUs and a boiling point of 100°C (212°F). This means that one pound of water at 100°C (212°F), will absorb 970 BTUs of heat in changing to vapor at 100°C (212°F). Conversely, the vapor will give off 970 BTUs of heat in condensing back to water to 100°C (212°F).

This tremendous heat transfer, occurring when a liquid boils or a vapor condenses, forms the basic principle of all conventional refrigeration systems.

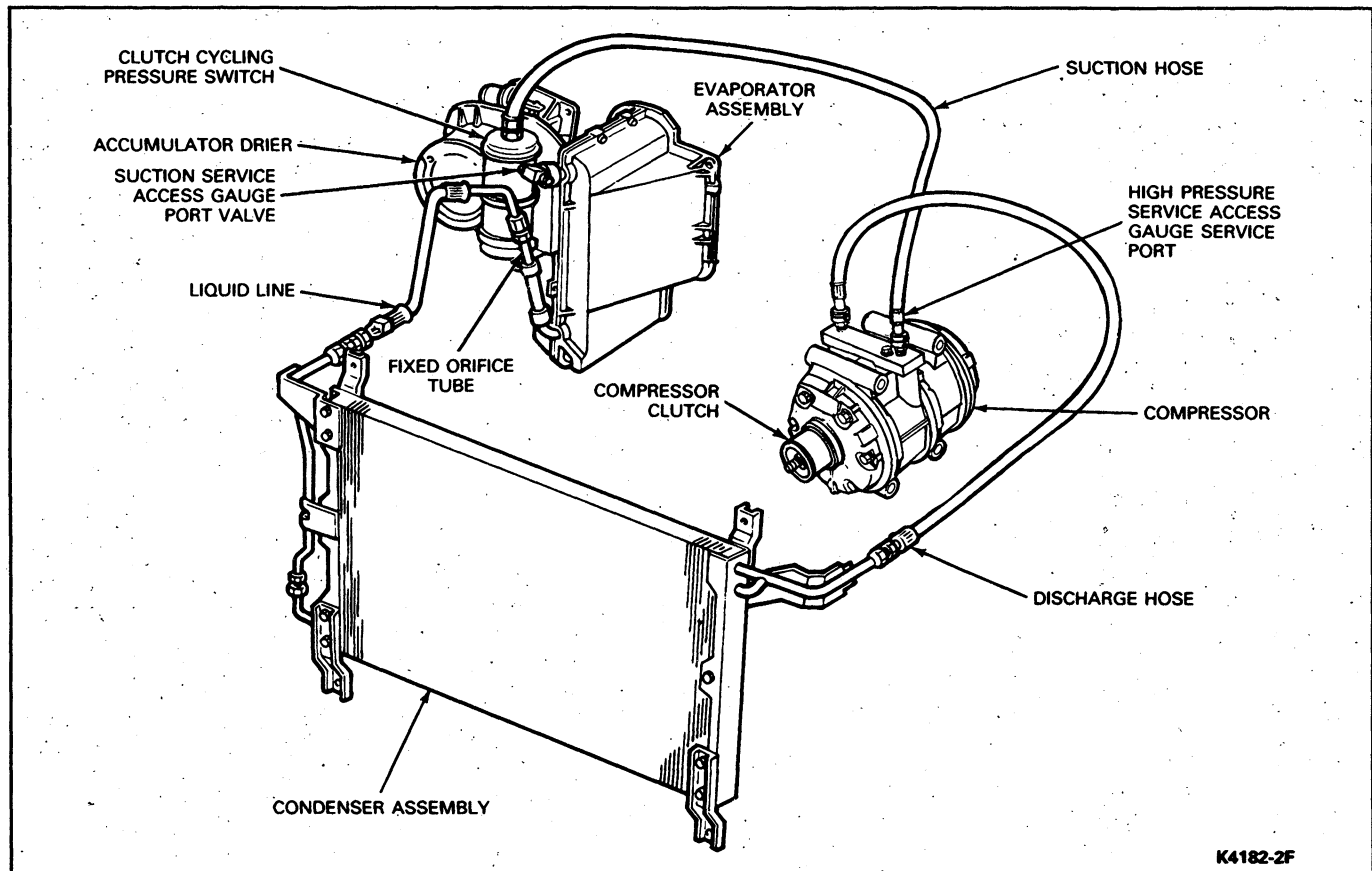
For a liquid to be a refrigerant, it must also have a low boiling point. That is, the temperature at which it boils must be lower than the substance to be cooled.

Refrigerant-12 is the liquid most commonly used in automotive air conditioning systems because in an open container it boils at -5.7°C (-21.7°F). It is a liquid that boils or vaporizes well below passenger compartment temperatures and, in vaporizing, will absorb tremendous amounts of heat without getting any warmer itself.

## Air Conditioner Components

### Suction Accumulator/Drier

The suction accumulator/drier is mounted on the side of the evaporator core and attaches directly to the



**FIG. 1 A/C Basic Fixed Orifice Refrigerant System**

evaporator outlet tube (Fig. 1). A suction service access gauge port valve is mounted on the inlet fitting of the suction accumulator/drier for F-Series. Its purpose is to provide service access to the suction side of the refrigerant system for pressure readings and system diagnosis. It also may be used for liquid charging the system when required. An inverted liquid diverter cup is internally mounted on top of the refrigerant vapor return tube, in the center of the suction accumulator/drier, to prevent the heavier, oil-laden liquid refrigerant from going directly into the compressor suction line. Upon entering the inlet of the suction accumulator/drier, heavier, oil-laden refrigerant contacts the liquid diverter cup, which serves as an umbrella, and drips down onto the bottom of the housing. A small diameter oil bleed hole, approximately  $1.1\text{mm} \pm 0.06\text{mm}$  ( $0.0445\text{ inch} \pm 0.0025\text{ inch}$ ) above the bottom of the housing, allows the accumulated heavier liquid refrigerant and oil mixture to re-enter the compressor suction line at a controlled rate. As the heavier liquid refrigerant and oil mixture pass through the small diameter liquid bleed hole, it has a second opportunity to re-vaporize and recirculate through the compressor without causing compressor damage due to slugging. A fine mesh screened filter fits tightly around the bottom of the vapor return tube to filter out refrigerant system contaminate particles and prevent them from plugging the oil bleed hole.

A desiccant bag is mounted inside the suction accumulator/drier tank assembly to absorb any moisture which may be in the refrigerant system.

Another fitting, on the suction accumulator/drier, is used to mount the clutch cycling pressure switch. It has

a long-travel Schrader-type valve stem core installed in the fitting opening to prevent refrigerant loss when the clutch cycling pressure switch is removed.

### Evaporator Core

The evaporator core is a multi-pass plate/fin aluminum core. The liquid line connects to the bottom of the core and the suction (low pressure) line connects to the top of the core. The liquid line tube is fitted with a fixed orifice to control refrigerant flow. This orifice can be removed from the evaporator core tube for replacement if it becomes necessary. However, a special tool is necessary to prevent breakage of the orifice.

### Expansion Valve—E-150—E-350 Auxiliary Unit

The expansion valve meters refrigerant into the evaporator according to cooling requirements. The restrictive effect of the expansion valve, while limiting the refrigerant flow to the evaporator, results in the reduced evaporator pressure.

The expansion valve consists of the valve and a temperature-sensing capillary tube and bulb. The valve is connected to the inlet tube of the evaporator and the sensing bulb is clamped to the outlet tube of the evaporator.

The expansion valve is opened and closed by opposing pressures on either side of the diaphragm. The temperature-sensing bulb which is clamped to the evaporator outlet tube usually contains Refrigerant-12. As evaporator outlet temperature rises, the Refrigerant-12 expands and exerts pressure against the diaphragm to open the valve further and admit more refrigerant into

the evaporator for increased cooling. As evaporator outlet temperature falls, the pressure against the diaphragm is decreased. Inlet pressure on the opposite side of the diaphragm then starts closing the valve. The valve tends to seek a position to control the Refrigerant-12 flow to maintain near maximum cooling from the evaporator.

### Fixed Orifice Tube

The fixed orifice tube is a restriction between the high and low pressure refrigerant and meters the flow of liquid refrigerant into the evaporator core.

The fixed orifice tube is located in the evaporator inlet tube and has filter screens on the inlet and outlet ends of the tube body. The filter screens act as strainers for the liquid refrigerant flowing through the fixed orifice opening. O-rings on the tube body prevent the high pressure liquid refrigerant from bypassing the orifice. Adjustment or repairs cannot be made to the fixed orifice tube assembly and it must be replaced as a unit. F-Series and Bronco vehicles use a 0.062-inch orifice tube color coded **red** and the Econoline main system use a 0.057-inch orifice tube color coded **orange**.

### A/C Compressor and Clutch

The refrigerant system uses a Ford-built swash-plate designed ten-cylinder compressor designated the FX-15 or a Nippondenso six-cylinder axial 6E171 compressor. The compressor is mounted on the side of the engine and is driven by a belt. Belt tension adjustment is obtained by means of an automatic tensioner (gasoline engines) or by moving the compressor braces away from the engine (diesel engines).

### High Pressure Relief Valve

Under extreme pressure conditions, the high pressure relief valve will momentarily open, allowing refrigerant vapor to escape. This relieves excessive pressure that might damage the compressor. The valve closes as soon as pressure is lower than the relief setting. This prevents loss of the complete refrigerant charge. The high pressure relief valve is located in the discharge manifold at the top of the compressor (Fig. 1).

### Condenser

Refer to Fig. 1.

The air conditioning condenser is located in front of the radiator. The condenser receives compressed (therefore heated) refrigerant gas from the compressor.

As the hot refrigerant gas flows through the condenser, it is cooled by air passing over the fins. The cooled, compressed refrigerant gas condenses to liquid refrigerant which flows directly to the evaporator through the fixed orifice tube in the evaporator inlet.

### Spring Lock Coupling

The spring lock coupling is a refrigerant line coupling held together by a garter spring inside a circular cage. When the coupling is connected, the flared end of the female fitting slips behind the garter spring inside the cage of the male fitting. The garter spring and cage then prevent the flared end of the female fitting from pulling out of the cage.

Two O-rings are used to seal between the two components of the coupling. These O-rings are made of special material and **must** be replaced with an O-ring made of the same material. The O-rings normally used in refrigerant system connections are not the same material and should not be used with the spring lock

coupling. Use only the O-rings listed in the Master Parts Catalog for the spring lock coupling.

A plastic indicator ring is used on spring lock couplings to indicate, during vehicle assembly, that the coupling is connected. Once the coupling is connected, the indicator ring is no longer necessary but will remain captive by the coupling near the cage opening.

After the coupling has been cleaned, install new O-rings lubricated with clean refrigerant oil. Connect the coupling together by pushing with a slight twisting motion. When the coupling is connected a distinct click or snap should be heard or felt, indicating positive engagement. If possible, visually inspect the cage to ensure that the flared end of the female fitting is fully behind the garter spring. Otherwise, push and pull on the fitting to verify engagement.

### Clutch Cycling Pressure Switch

The clutch cycling pressure switch is mounted on a Schrader valve-type fitting on the accumulator/drier assembly. A valve depressor, located inside the threaded end of the pressure switch, depresses the Schrader valve stem as the switch is mounted and allows the suction pressure inside the accumulator/drier housing to control the switch operation. The electrical switch contacts are normally open when the suction pressure is at or below 169 kPa (24.5 psi); they will close when the suction pressure rises to approximately 293 kPa (43.5 psi) or above. Lower ambient temperatures (below 9°C or 48°F), during cold weather seasons, will also open the clutch cycling pressure switch contacts due to the pressure/temperature relationship of the refrigerant in the system. The electrical switch contacts control the electrical circuit to the compressor's magnetic clutch coil. When the switch contacts are closed, the clutch coil is energized and the A/C clutch is engaged to drive the compressor. When the switch contacts are open, the compressor's magnet clutch coil is deenergized, the A/C clutch is disengaged and the compressor does not operate. The clutch cycling pressure switch, when functioning properly, will control the evaporator core pressure at a point where the plate/fin surface temperature will be maintained slightly above freezing which prevents evaporator icing and the blockage of airflow.

### Service Access Gauge Port Valves

These valves are similar to a tire valve (Figs. 3 and 4). The service valve in the high pressure line (from compressor to condenser) allows access to the high pressure side of the system for attaching a service hose and pressure gauge. The service valve in the low pressure line (from evaporator to compressor) allows access to the low pressure side of the system for attaching a service hose and pressure gauge. High pressure service valve adapters are shown in Fig. 4. An additional low pressure gauge port valve adapted to the accumulator is available for attaching a service hose or pressure gauge. Refer to Tee Adapter Tool procedure as outlined in this Section.

### DIAGNOSIS AND TESTING

Diagnosis is more than following a series of interrelated steps to find the solution to a specific condition. It is a way of looking for systems that are not functioning properly and finding out why. Also, it is knowing how the system should work, and whether it is working correctly.

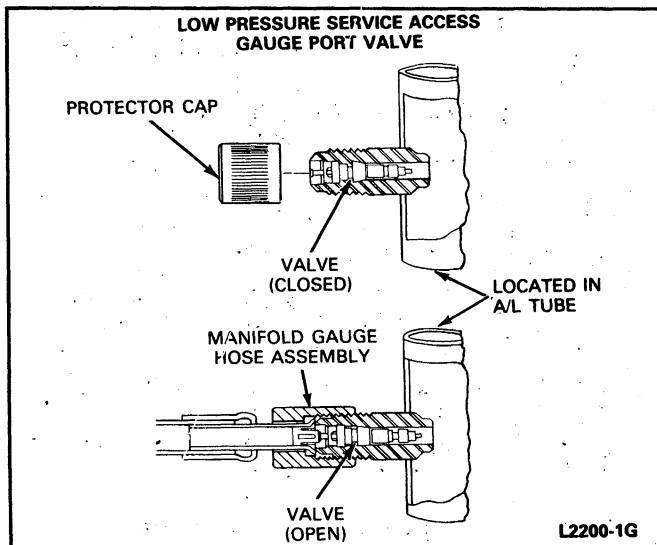


FIG. 2 Low Pressure Gauge Port Valve

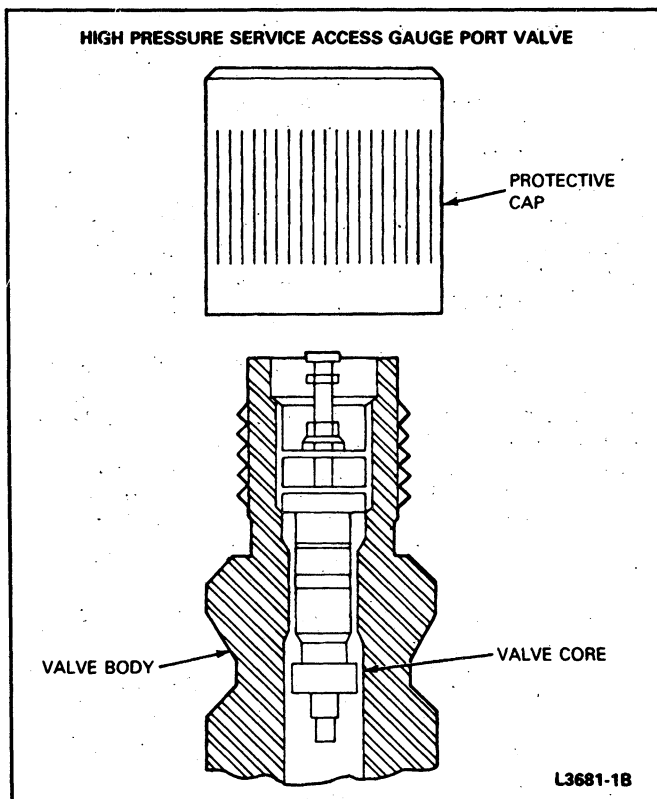


FIG. 3 High Pressure Gauge Port Valve

### Know the System

Know how the parts go together and how the system operates, as well as its limits and what happens when something goes wrong. This may require checking the system against a known good system.

### Know the History of the System

Know how old the system is and its service history, which might relate to the present condition. A clue in these areas may save time.

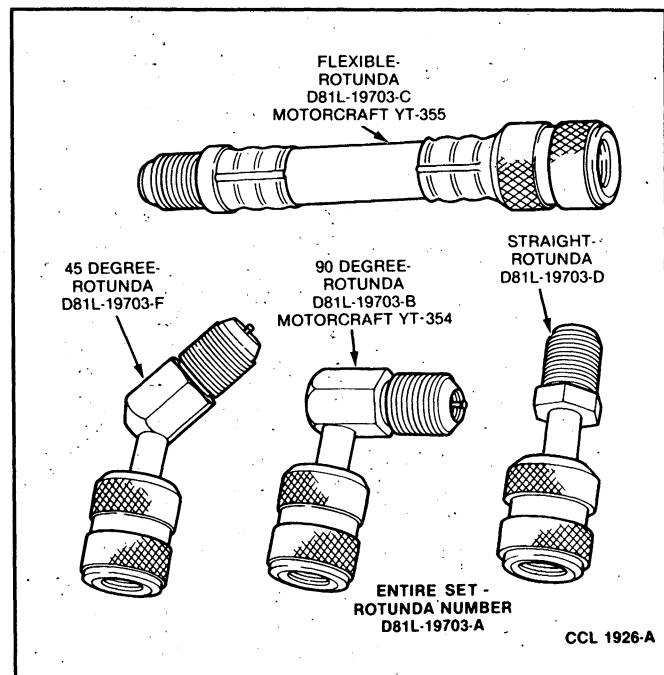


FIG. 4 High Pressure Gauge Port Valve Adapters

### Know the History of the Condition

Find out if the condition started suddenly or gradually, or whether it was related to some other occurrence like an accident or another component that was replaced. Knowing how the condition was discovered may be an important clue to the cause.

### Know the Probability of Certain Conditions Developing

Most conditions are caused by simple things rather than by complex ones, and they occur in a fairly predictable pattern. Electrical problem conditions usually occur at connections rather than in components. An engine "no start" is more likely to be caused by a loose wire or a component out of adjustment than a sheared-off camshaft. To avoid spending unnecessary diagnosis time, do not eliminate certain failures unless sure that these failures are impossible. Also, although a part may be new, it is no guarantee that the part is functioning properly.

### Safety Precautions

The refrigerant used in the air conditioning system is Refrigerant-12. Refrigerant-12 is non-explosive, non-flammable, noncorrosive, has practically no odor, and is heavier than air. Although it is classified as a safe refrigerant, certain precautions must be observed to protect the parts involved and the person who is working on the unit.

**CAUTION: Use only Refrigerant-12. Do not use refrigerant that is canned for pressure-operated accessories (such as boat air horns). This type is not pure Refrigerant-12 and will cause a malfunction.**

**WARNING: AVOID CONTACT OF LIQUID REFRIGERANT-12 WITH SKIN AND EYES. AT NORMAL ATMOSPHERIC PRESSURES AND TEMPERATURES, REFRIGERANT-12 EVAPORATES SO QUICKLY THAT IT HAS THE TENDENCY TO FREEZE ANYTHING IT CONTACTS. SHOULD LIQUID REFRIGERANT COME IN CONTACT WITH THE**

**EYES, IMMEDIATELY WASH WITH A FEW DROPS OF MINERAL OIL FOLLOWED BY A WEAK BORIC ACID SOLUTION. CONTACT A PHYSICIAN IMMEDIATELY.**

**WARNING: ALWAYS WEAR SAFETY GOGGLES WHEN SERVICING ANY PART OF THE REFRIGERANT SYSTEM. REFRIGERANT-12 IS ALWAYS UNDER PRESSURE. BECAUSE THE SYSTEM IS TIGHTLY SEALED, HEAT APPLIED TO ANY PART OF THE SYSTEM WILL CAUSE EXCESSIVE PRESSURE BUILDUP. TO AVOID A DANGEROUS EXPLOSION, NEVER WELD, USE A BLOW TORCH, SOLDER, STEAM CLEAN, BAKE BODY FINISHES OR USE AN EXCESSIVE AMOUNT OF HEAT ON OR IN THE IMMEDIATE AREA OF ANY PART OF THE AIR COOLING SYSTEM OR REFRIGERANT SUPPLY TANK, WHILE CLOSED TO ATMOSPHERE, WHETHER FILLED WITH REFRIGERANT OR NOT.**

**WARNING: LIQUID REFRIGERANT EVAPORATES RAPIDLY, DISPLACING AIR WHERE THE REFRIGERANT IS RELEASED. TO PREVENT POSSIBLE SUFFOCATION IN ENCLOSED AREAS, DISCHARGE THE REFRIGERANT FROM AN AIR COOLING SYSTEM INTO THE GARAGE EXHAUST COLLECTOR. MAINTAIN GOOD VENTILATION SURROUNDING THE WORK AREA.**

**WARNING: ALTHOUGH REFRIGERANT-12 GAS, UNDER NORMAL CONDITIONS, IS NON-POISONOUS, THE DISCHARGE OF REFRIGERANT GAS NEAR AN OPEN FLAME CAN PRODUCE A VERY POISONOUS GAS. IT IS GENERATED WHEN THE FLAME-TYPE LEAK DETECTOR IS USED. AVOID INHALING FUMES FROM THE LEAK DETECTOR. MAKE CERTAIN THAT REFRIGERANT-12 IS STORED AND INSTALLED IN ACCORDANCE WITH ALL STATE AND LOCAL ORDINANCES.**

**CAUTION: When admitting Refrigerant-12 gas into the cooling unit, keep the tank in an upright position. If the tank is on its side or upside down, liquid Refrigerant-12 will enter the system and damage the compressor.**

#### Service Precautions

Observe the following service precautions.

1. Never open or loosen a connection before discharging the system.
2. When loosening a connection, if any residual pressure is evident, allow it to leak off before opening the fitting.
3. Evacuate a system which has been opened to replace a component or one which has discharged through leakage before charging.
4. Seal open fittings with a cap or plug immediately after disconnecting a component from the system.
5. Clean the outside of the fittings thoroughly before disconnecting a component from the system.
6. Do not remove the sealing caps from a replacement component until ready to install.
7. Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open an oil container until ready to use and install the cap immediately after using. Store the oil only in a clean, moisture-free container.
8. Install a new seal ring before connecting an open fitting. Coat the fitting and seal with refrigerant oil before connecting.
9. When installing a refrigerant line, avoid sharp bends. Position the line away from the exhaust or any sharp edges which may chafe the line.
10. Tighten fittings only to specifications. The steel and aluminum fittings used in the refrigeration system will not tolerate over tightening.
11. When disconnecting a fitting, use a wrench on both halves of the fitting to prevent twisting of the refrigerant lines or tubes.
12. Do not open a refrigerant system or uncap a replacement component unless it is as close as possible to room temperature. This will prevent condensation from forming inside a component which is cooler than the surrounding air.
13. Keep service tools and the work area clean to avoid contamination of a refrigerant system.

#### System Visual Inspection

It is possible to detect problem causes by a careful visual inspection of the A/C refrigerant system. This includes broken belts, obstructed condenser air passages, a loose clutch, loose or broken mounting brackets, disconnected or broken wires and many refrigerant leaks.

A refrigerant leak will usually appear as an oily residue at the leakage point in the system. The oily residue soon picks up dust or dirt particles from the surrounding air and appears greasy. Through time, this will build up and appear to be a heavy dirt-impregnated grease.

Most common leaks are caused by damaged or missing O-ring seals at the various hose and component connections. When these O-rings are replaced, lubricate the new O-rings with refrigerant oil. Be careful to keep shop towel lint from contaminating the internal surfaces of the connection. Leakage may occur at a spring lock coupling if the wrong O-rings are used at the coupling. Use **only** the O-rings listed in the Ford Master Parts Catalog for the spring lock coupling.

If the system contains no refrigerant or is extremely low on refrigerant, the clutch will not engage for compressor operation. A rapid cycling compressor clutch is usually an indication that the system is low on refrigerant. Also, clutch cycling will normally not occur when the engine is operating at curb idle speed.

#### Tee Adapter Tool

A Tee Type Service Adapter tool D87P-19703-A or equivalent may be used to diagnose the low pressure side of the refrigerant system. The tool is shown installed in Fig. 5.

1. Disconnect electrical connector at clutch cycling pressure switch and remove switch from switch fitting.
2. Install a new clutch cycling pressure switch and O-ring on adapter tool (Fig. 5), and plan to leave it on adapter as a permanent part of tool. Lubricate O-ring before installation.
3. Install tee adapter tool on clutch cycling pressure switch fitting and tighten it securely.
4. Connect low pressure hose of manifold gauge set to side fitting of Tee Adapter tool.



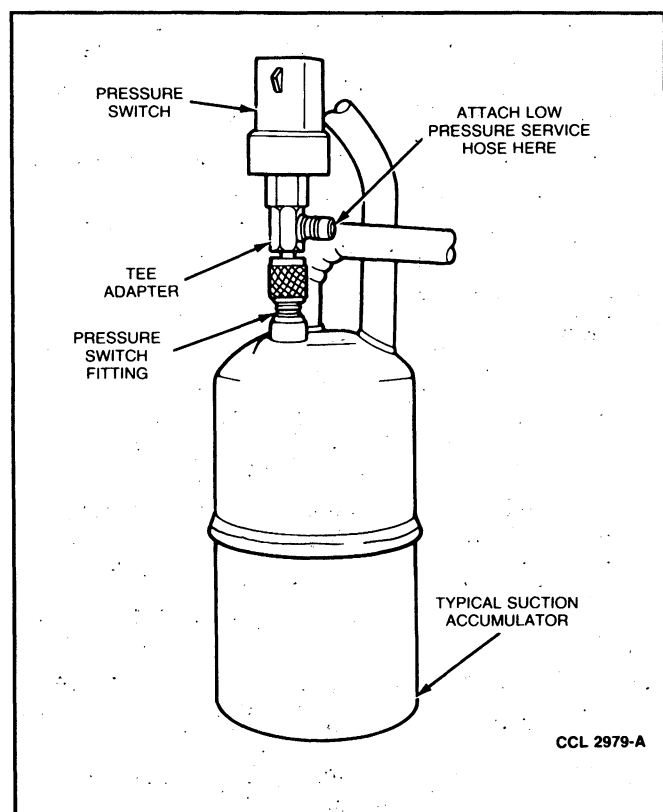


FIG. 5 Tee Adapter Tool Installation

5. Connect electrical connector to clutch cycling pressure switch on Tee Adapter tool.

With the Adapter Tool installed in this manner, the refrigerant system can be operated under normal conditions with clutch cycling pressure switch control and evaporator (suction) pressure may be observed. This provides a more accurate low pressure reading than can be obtained from a low pressure gauge port located in the suction line or near the compressor.

After completing the repair, disconnect the manifold gauge set from the Adapter Tool. Disconnect the electrical connector from the clutch cycling pressure switch on the tool and remove the tool from the pressure switch fitting. Install the removed clutch cycling pressure switch and connect the electrical connector.

## ADJUSTMENTS

### Discharge the System

Discharge the refrigerant from the system before replacing any part of the system (except the compressor vehicles with manual valves). On vehicles with manual valves, make sure valves are back-seated.

1. Remove caps from high and low pressure service gauge port valves in high and low pressure lines.
2. Turn both manifold gauge valves fully clockwise to close gauge set to center outlet hoses.
3. If gauge set hoses do not have service valve actuating pins, install Straight Adapter T71P-19703-S and Curved Adapter T71P-19703-R or equivalent on manifold gauge low pressure hose. Install a special adapter coupler on high pressure hose.

4. Connect high and low pressure gauge hoses with adapters to respective high and low pressure service gauge port valves.
5. Place open end of center hose in a garage exhaust outlet.
6. Slowly de-pressurize refrigeration system by opening low pressure gauge valve a slight amount and allowing refrigerant to discharge slowly from system.
7. After system is nearly discharged, open high pressure gauge valve very slowly to avoid losing an excessive amount of refrigerant oil. Allow any refrigerant remaining in compressor and high pressure line to discharge.

## Evacuating the System

1. Discharge refrigerant system as outlined.
2. Be certain manifold gauge set is connected as follows:
  - a. Low pressure hose connected to low pressure service gauge port on top center of the accumulator/drier assembly.
  - b. High pressure hose to high pressure gauge port on compressor discharge line at condenser connection. An adapter is necessary at this service gauge port.
  - c. Connect manifold gauge set center hose to a vacuum pump.
3. Open manifold gauge set valves and start vacuum pump.
4. Evacuate system with vacuum pump until low pressure gauge reads at least 84 kPa (25 in. Hg) (vacuum) and as close to 101 kPa (30 in. Hg) as possible. Continue vacuum pump operation for 15 minutes. If part of system has been replaced, continue vacuum pump operation for an additional 20-30 minutes.
5. When evacuation of system is complete, close manifold gauge set valves and turn vacuum pump off.
6. Observe low side gauge to ensure system holds vacuum for 5 minutes. If vacuum is held for 5 minutes, proceed to charging the system. If vacuum is not held for 5 minutes, leak test system, repair leak(s) and again evacuate system.

## Charging the System

1. With manifold gauge set valve closed to center hose, disconnect vacuum pump from manifold gauge set.
2. Connect center hose of manifold gauge set to a refrigerant drum.

**WARNING: USE ONLY A SAFETY TYPE DISPENSING VALVE. THE REFRIGERANT CANS ARE UNDER PRESSURE AND COULD CAUSE PERSONAL INJURY IF NOT PROPERLY HANDLED.**

3. Loosen center hose at manifold gauge set and open refrigerant drum valve. Allow refrigerant to escape to purge air and moisture from center hose. Then, tighten center hose connection at manifold gauge set.
4. Disconnect wire harness snap-lock connector from clutch cycling pressure switch and install a jumper wire across two terminals of connector.

5. Open manifold gauge set low side valve to allow refrigerant to enter system. Keep refrigerant can in an upright position if vehicle low pressure service gauge port is not on suction accumulator/drier or suction accumulator fitting.
6. When no more refrigerant is being drawn into system, start engine, move blower switch to HI and move Function selector lever to MAX A/C.

Continue to add refrigerant to system until specified weight of Refrigerant-12 is in system. Then, close manifold gauge set low pressure valve and refrigerant supply valve.

7. Remove jumper wire from clutch cycling pressure switch snap-lock connector and connect connector to pressure switch.
8. Operate system until the pressures stabilize to verify normal operation and system pressures.
9. In high ambient temperatures, it may be necessary to operate a high volume fan positioned to blow air through radiator and condenser to aid in cooling the engine and prevent excessive refrigerant system pressures.
10. When charging is completed and system operating pressures are normal, disconnect manifold gauge set from vehicle. Install protective caps on service gauge port valves.

### **Purging the Refrigerant System to Remove Air and Moisture Vapor**

The triple evacuation procedure should be employed when there are definite indications of moisture in the system. This procedure is effective in removing small amounts of moisture from the refrigerant system. However, if the system is contaminated with a large quantity of water, complete system flushing will be required.

The principle of the three evacuations is simple. The first pull-down removes approximately 90 percent of the air and moisture vapors.

The first purge with new, dry Refrigerant-12 mixes with the remaining 10 percent.

With the next evacuation, this mixture will be drawn out so that only approximately one percent of the initial air and moisture vapors remain.

The second purge with new, dry Refrigerant-12 will mix with this one percent, and the third evacuation will finish the job by drawing out practically all the remaining vapors.

But, if any water was present in the system at the start of this procedure, most of it will still be there, because a short period of vacuum is not long enough to boil and vaporize the water. The Refrigerant-12 purges, in passing over the liquid, will absorb only a relatively small amount of water.

This procedure is effective only when no water is in the system. It should not be used if there is any indication of water in the system.

### **Cleaning a Badly Contaminated Refrigerant System**

A refrigerant system can become badly contaminated for a number of reasons.

- The compressor may have failed due to damage or wear.

- The compressor may have been run for some time with a bad leak or any opening in the system.
- The system may have been damaged by a collision and left open for a long time.
- The system may not have been cleaned properly after a previous failure.
- The system may have been operated for a time with water or moisture in it.
- Clutch cycle rate is fast.
- Clutch ON time is short.
- Clutch OFF time is short.

The evaporator bore is causing the problem. Airflow is restricted, indicating leaves or debris entering through the cowl air inlet and plugging the core.

This condition can also be detected by checking the center register discharge temperature. An abnormally low temperature indicates air is spending more time in the evaporator and is very cold when discharged, although the volume is not enough to cool the car properly.

Additional cause components are listed at the bottom of the chart (Fig. 11) for poor compressor operation or a damaged compressor condition.

These diagnosis charts provide the most direct and sure way to determine the cause of any problem in a poorly performing refrigerant system.

After servicing and correcting a refrigerant system problem, take additional pressure readings and observe the clutch cycle rate while meeting the conditional requirements (Fig. 10) to be sure the problem has been corrected.

In ambient temperatures above 38°C (100°F), the compressor clutch will not normally cycle off (Figs. 9 and 10) and in many instances, the clutch will not cycle off when temperatures are above 32°C (90°F).

Another type of leak may appear at the internal Schrader-type A/C charging valve core in the service gauge port valve fittings. If tightening the valve core does not stop the leak, replace it with a new A/C charging valve core (part number 19D701) or equivalent.

Missing service gauge port valve caps (19D702 or equivalent) can also cause a refrigerant leak. If this important primary seal (the valve cap) is missing, dirt will enter the area of the A/C charging valve core. When the service hose is attached, the valve compressor in the end of the service hose forces the dirt into the valve seat area and the dirt will destroy the sealing surface of the A/C charging valve core. When a service gauge port valve cap is missing, clean the protected area of the A/C charging valve core and install a new 19D702 service gauge port valve cap.

**CAUTION: Service gauge port valve caps must be installed finger-tight. If tightened with pliers, the sealing surface of the service gauge port valve may be damaged.**

### **Mini-Tube Vacuum Hose**

#### **Service**

1. Measure the length of the damaged area of the mini-tube vacuum hose.

2. Cut a piece of standard 3mm (1/8-inch) ID vacuum hose approximately 25mm (1-inch) longer than the damaged area of the mini-tube vacuum hose.
3. Cut off the mini-tube vacuum hose on each side of the damaged area.
4. Dip the mini-tube hose ends in Tetra Hydro Furan (THF) or Methyl Ethyl Ketone (MEK). This solvent will seal the mini-tube in the vacuum hose.
5. Insert the ends of the mini-tube vacuum hose (Fig. 6) approximately 9mm (3/8-inch) into the ends of the standard 3mm (1/8-inch) service vacuum hose section.
6. Shake the service joint after assembly to make sure the solvent is dispersed and the vacuum line is not plugged.
7. Test the system for a vacuum leak in the service area.

### Attaching the Manifold Gauge Set

When performing any of the various tests, test equipment must be connected to the refrigerant system. If charge station-type equipment is used, follow the instructions of the manufacturer.

To attach a manifold gauge set (Fig. 7) (part of Rotunda Manifold Gauge Set 063-00010 or equivalent) to the service access gauge port valves, proceed as follows:

1. Turn both manifold gauge set valves fully clockwise to close high and low pressure hoses at gauge.
2. Remove caps from high and low pressure service (Schrader) access gauge port valves in high and low pressure lines (Figs. 2 and 3).

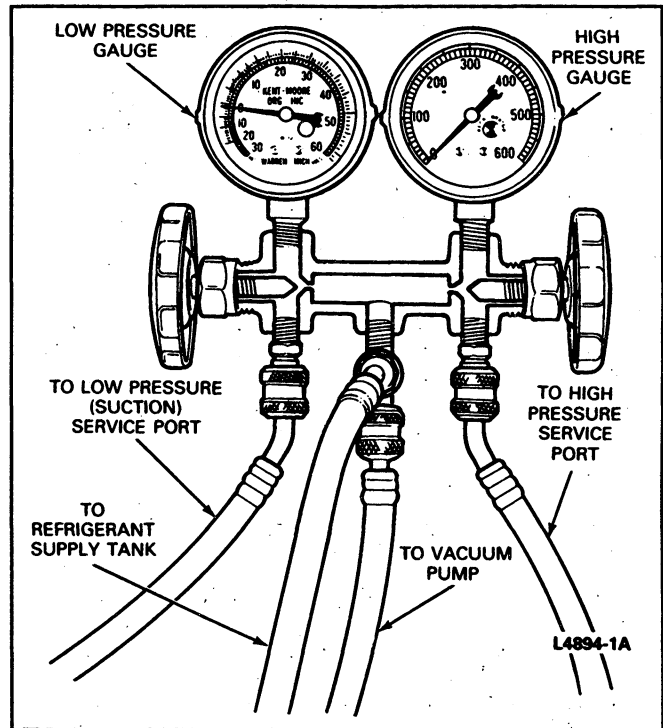


FIG. 7 Manifold Gauge Set

3. If refrigerant hoses do not have valve depressing pins in them, install Straight Adapter T71P-19703-S or Curved Adapter T71P-19703-R or equivalents (containing valve depressing pins) on manifold gauge set low and high pressure hoses.

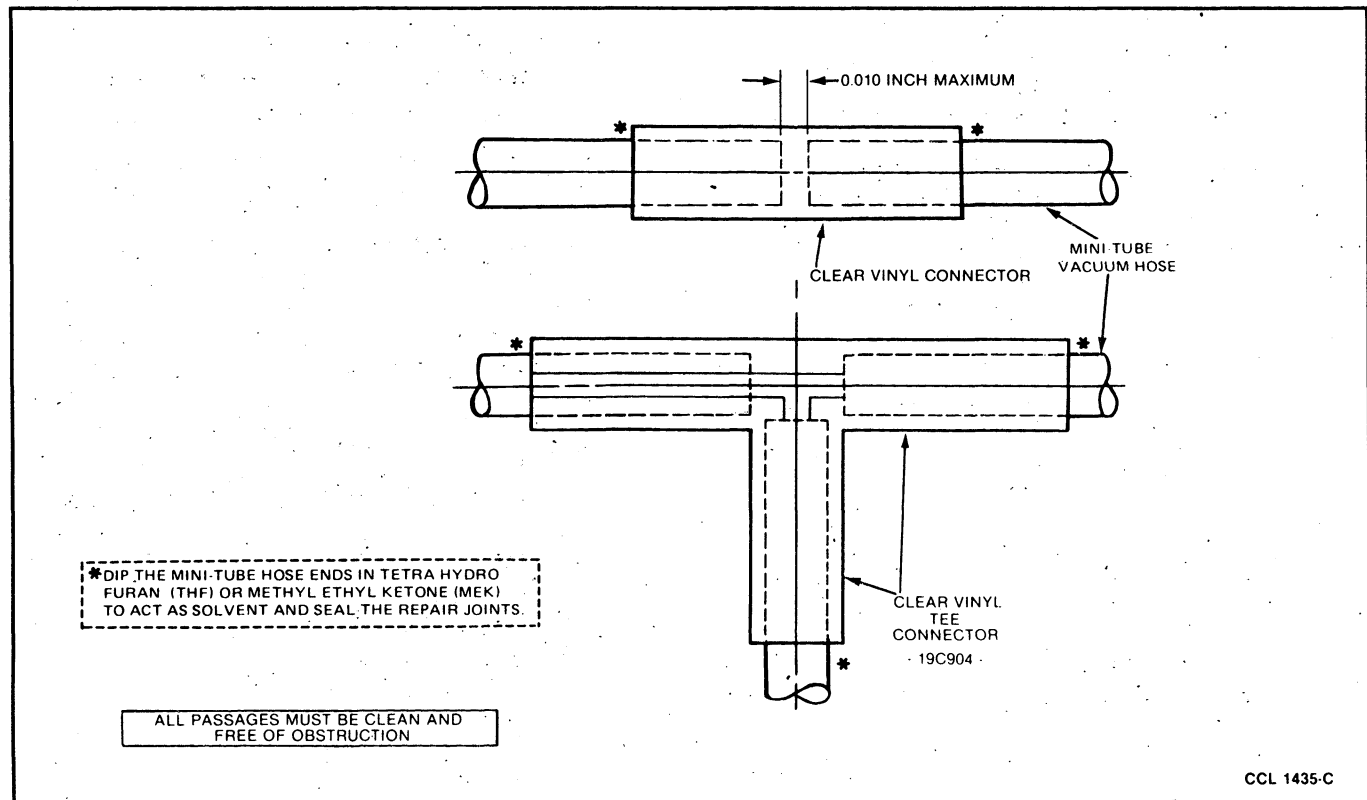


FIG. 6 Mini-Tube Vacuum Hose Service

4. Connect high and low pressure refrigerant hoses with depressing pins or adapters containing depressing pins to respective high and low pressure service access gauge port valves. The special adapter shown in Fig. 4 must be used on high pressure service access gauge port valve.
5. Connect hoses attached to manifold center fitting to refrigerant supply tank and vacuum pump valves.

### Checking For Leaks

NOTE: When checking for freon leaks with either a propane flame-type tester or an electronic beeper-type tester the technician should be aware of whatever chemicals are present in the testing area which might affect test results. Some of these chemical compounds which might alter test results are disc brake cleaner, diesel fuel, antifreeze, etc.

Attach the manifold gauge set (Fig. 7). Leave both manifold gauge set valves at the maximum clockwise position. Both gauges should show approximately 414-551 kPa (60-80 psi) at 23.9°C (75°F) with the engine not running. If very little or no pressure is indicated, leave the vacuum pump valve closed, open the Refrigerant-12 tank valve, and turn the low pressure (suction) manifold gauge set valve to the counterclockwise position. This opens the system to tank pressure. Check all connections, and the compressor head gasket, oil filter plug, and the shaft seal for leaks using a flame-type leak detector or Rotunda Flame-Type Detector 023-00006 (Motorcraft YT-202) or equivalent (Fig. 8).

NOTE: Use compressed air to blow off excessive oil from the shaft seal area to reduce the possibility of an erroneous detection of freon retained in the refrigerant oil.

### Flame-Type Leak Detector

Avoid inhaling the fumes from the leak detector. Follow the directions with the leak detector.

The smaller the flame on the flame-type detector the more sensitive it is to leaks. Therefore, to ensure accurate leak indication, keep the flame as small as possible. The copper element must be red hot. If it is burned, always replace the element. Hold the open end of the hose below each suspected leak point for two or three seconds. The flame will normally be almost

colorless. The slightest leak will be indicated by a bright green blue color to the flame. Be sure to check the manifold gauge set and hoses for leaks as well as the rest of the system.

**If the surrounding air is contaminated with refrigerant gas, the leak detector will indicate this gas all the time. Good ventilation is necessary to prevent this situation. A fan, even in a well ventilated area, is very helpful in removing small traces of refrigerant vapor.**

### Refrigerant System

To diagnose a problem in the refrigerant system, note the system pressure (shown by the manifold gauges) and the clutch cycle rate. Then compare readings to the charts shown in Figs. 9 and 10.

- The system pressures are low (compressor suction) and high (compressor discharge).
- A clutch cycle is the time the clutch is engaged plus the time it is disengaged (time on plus time off).
- Clutch cycle times are the lengths of time (in seconds) that the clutch is on or off.

To achieve accurate diagnosis results in the least amount of time use the following procedure and refer to Figs. 9 and 10.

NOTE: The test conditions specified at the top of each of the charts must be met to obtain accurate test results.

1. Connect a manifold gauge set to the system.
2. When system has stabilized, record high and low pressures as shown by manifold gauges.
3. Determine clutch cycle rate per minute (clutch ON time plus OFF time is a cycle).
4. Record clutch OFF time in seconds.
5. Record clutch ON time in seconds.
6. Note center register discharge temperature.
7. Determine and record ambient temperature.
8. Compare test readings and appropriate chart (Figs. 9 and 10).

- Plot a vertical line for recorded ambient temperature from scale at bottom of each chart to top of chart.
- Plot a horizontal line for other test readings from scale at LH side of appropriate chart.

If the point where the two lines cross on each chart falls within the dark band, the system is operating normally. If the lines cross outside the dark band on one or more of the charts, there is a problem and the specific cause must be determined. Refer to the Refrigerant System and Clutch Cycle Timing Evaluation chart (Fig. 11). NOTE: The following five system operating conditions are indicated by where the lines cross on the chart:

- System high (discharge)—pressure is high, low or normal.
- System low (suction)—pressure is high, low or normal.
- Clutch cycle rate is fast, slow or clutch runs continuously.
- Clutch ON time is long or short.
- Clutch OFF time is long or short.

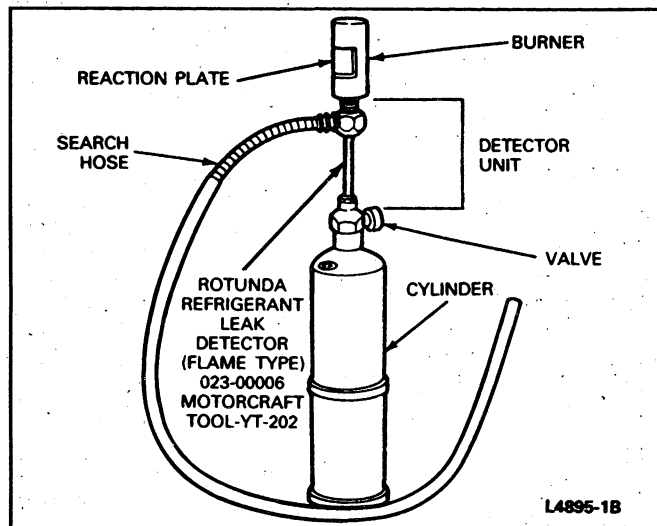
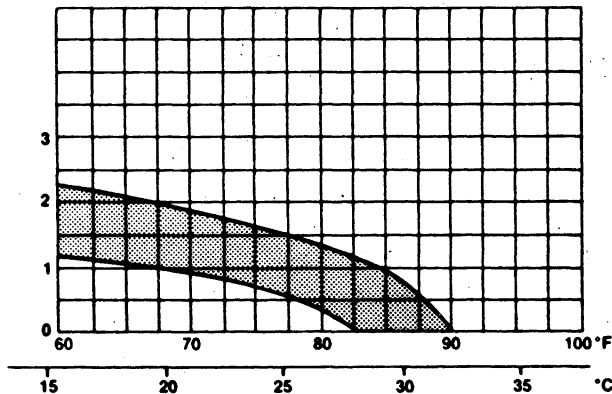


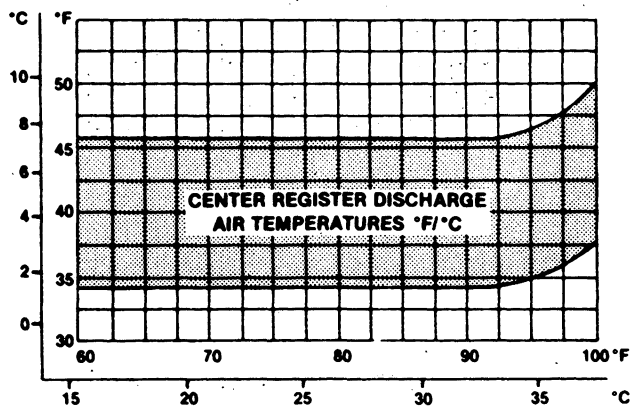
FIG. 8 Flame-Type Leak Detector

### NORMAL CLUTCH CYCLE RATE PER MINUTE CYCLES/MINUTE



### AMBIENT TEMPERATURES

### NORMAL CENTER REGISTER DISCHARGE TEMPERATURES

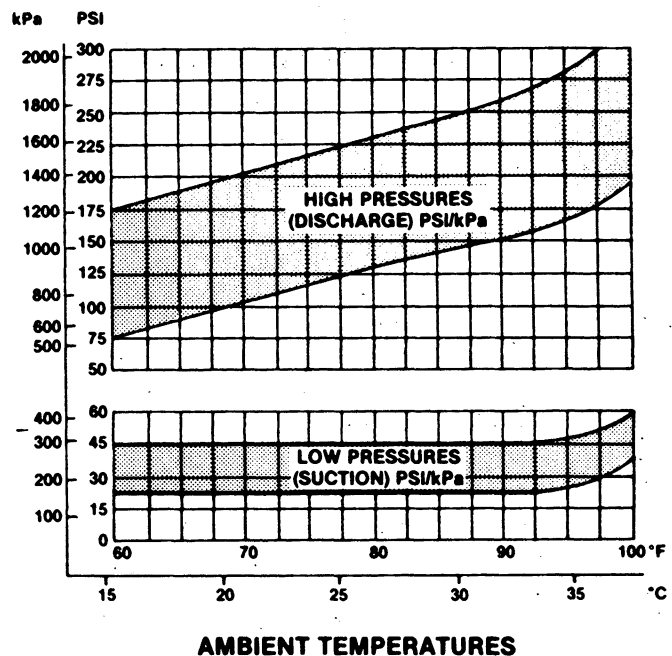


### AMBIENT TEMPERATURES

THESE CONDITIONAL REQUIREMENTS FOR THE  
FIXED ORIFICE TUBE CYCLING CLUTCH SYSTEM  
TESTS MUST BE SATISFIED TO OBTAIN ACCURATE  
PRESSURE READINGS.

- Stabilized in Car Temperatures @ 70°F to 80°F (21°C to 27°C)
- Maximum A/C (Recirculating Air)
- Maximum Blower Speed
- 1500 Engine RPM For 10 Minutes

### NORMAL FIXED ORIFICE TUBE CYCLING CLUTCH REFRIGERANT SYSTEM PRESSURES



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FIG. 9 Normal Fixed Orifice Tube Cycling Clutch Refrigerant System Pressure/Temperature Relationships

Match these conditions to the conditions shown in the five columns toward the left in the System Pressure and Clutch Cycle Timing Evaluation chart (Fig. 11). All five system conditions will be indicated on one line. The most likely component or components causing the problem are listed in the RH column.

#### Example:

- High (discharge)—pressure is low.
- Low (suction)—pressure is normal.
- Clutch cycle rate is very fast.
- Clutch ON time is very short.
- Clutch OFF time is very short.

In this example, the problem is caused by the clutch cycling pressure switch. The clutch cycling range is too close. Replace the switch and recheck the system.

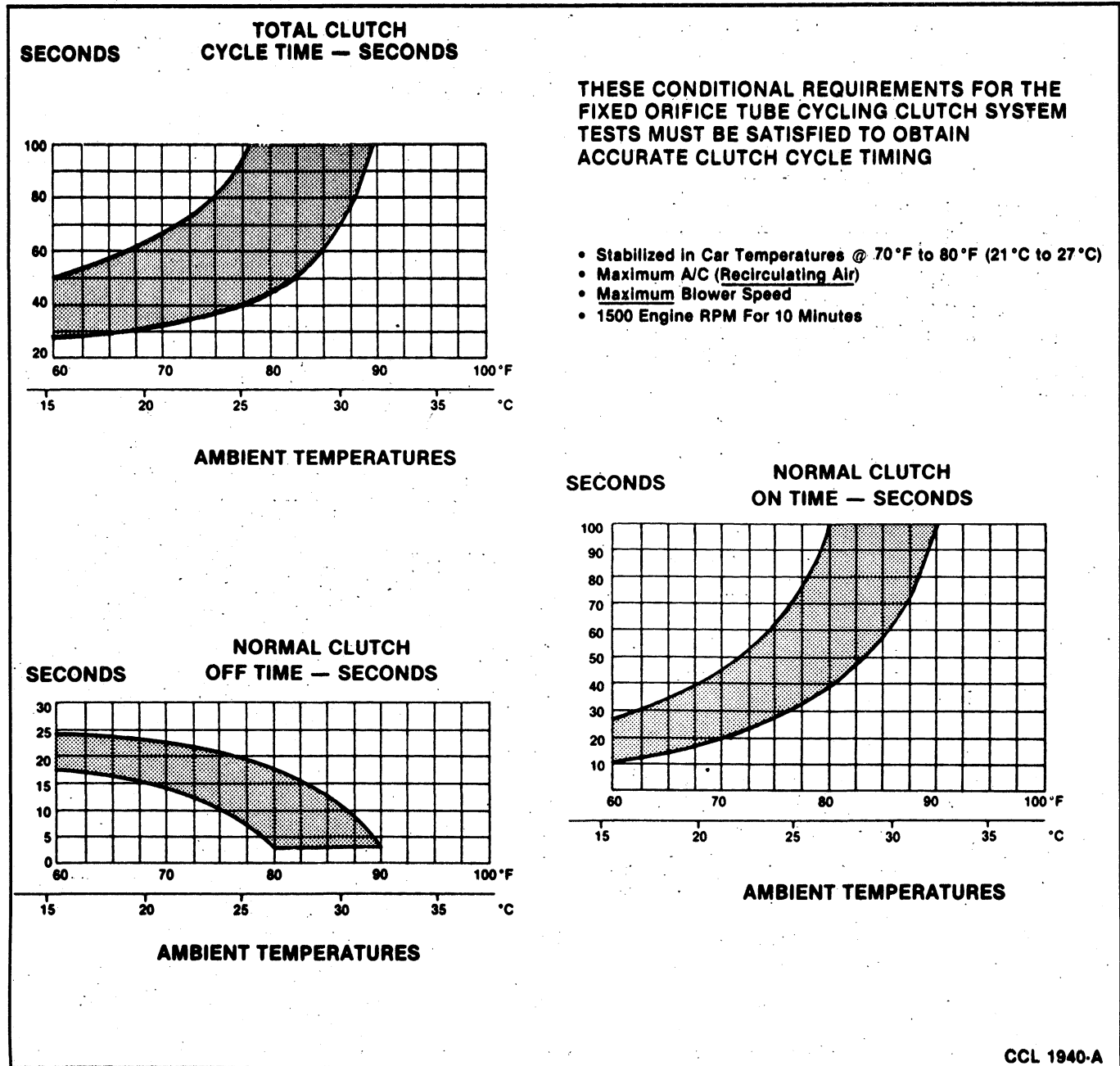
#### Example

- High (discharge)—pressure is normal to low.
- Low (suction)—pressure is normal.

A badly contaminated system contains water, carbon and other decomposition products. Where such a condition exists, the system must be flushed with a special flushing agent using equipment designed especially for this purpose. Follow the suggestions and procedures outlined to ensure a proper cleaning job.

#### Flushing Agents

To be suitable as a flushing agent, a refrigerant must remain in the liquid state during the flushing operation, in order to wash the inside surfaces of the system components. Refrigerant vapor will not remove contaminant particles. They must be flushed with a



**FIG. 10 Normal Clutch Cycle Rates and Times—Fixed Orifice Tube System**

liquid. Some refrigerants are better suited for this purpose than others. Refer to Fig. 12.

The chart (Fig. 12) shows the pressure/temperature relationship and the vaporization/temperature relationship for four refrigerants. Neither Refrigerant-12 nor Refrigerant-114 is suitable for flushing a system because of low vaporization (boiling) points (-5.78°C (21.6°F) for Refrigerant-12 and 3.55°C (38.4°F) for Refrigerant-114). Both these refrigerants would be difficult to use and would not do a good job because of their tendency to vaporize rather than remain in the liquid state, especially in high ambient temperatures.

The other two refrigerants listed in the chart (Refrigerant-11 and Refrigerant-113) are much better suited for use with special flushing equipment. Both have rather high vaporization points (23.4°C (74.7°F) for Refrigerant-11 and 47°C (117.6°F) for Refrigerant-113).

Also, both refrigerants have low closed container pressures. This reduces the danger of an accidental system discharge because of a ruptured hose or fitting. Flushing Refrigerant-113 is recommended. Both Refrigerant-11 and Refrigerant-113 require a propellant or pump-type flushing equipment because of their low closed container pressures. Refrigerant-12 can be used as a propellant with either flushing refrigerant. Refrigerant-11 is available in pressurized containers. Although not recommended for regular use, it might become necessary if special flushing equipment is not available. Handle with care as it is more toxic than the other refrigerants.

**CAUTION: Use extreme care and follow all safety precautions related to the use of refrigerants when flushing a system.**

## REFRIGERANT SYSTEM PRESSURE AND CLUTCH CYCLE TIMING EVALUATION CHART FOR FIXED ORIFICE TUBE CYCLING CLUTCH SYSTEMS

NOTE: System test requirements must be met to obtain accurate test readings for evaluation. Refer to the normal refrigerant system pressure/temperature and the normal clutch cycle ratio and times charts.

High (Discharge) Pressure	Low (Suction) Pressure	Clutch Cycle Time			Component — Causes
		Rate	On	Off	
High	High	Continuous Run			Condenser — Inadequate Airflow
High	Normal to High				Engine Overheating
Normal to High	Normal				Air in Refrigerant Refrigerant Overcharge (a) Humidity or Ambient Temp Very High (b)
Normal	High				Fixed Orifice Tube — Missing O Rings Leaking/Missing
Normal	High	Slow	Long	Long	Clutch Cycling Switch — High Cut In
Normal	Normal	Slow or No Cycle	Long or Continuous	Normal or No Cycle	Moisture in Refrigerant System Excessive Refrigerant Oil
		Fast	Short	Short	Clutch Cycling Switch — Low Cut In or High Cut Out
Normal	Low	Slow	Long	Long	Clutch Cycling Switch — Low Cut Out
Normal to Low	High	Continuous Run			Compressor — Low Performance
Normal to Low	Normal to High				A/C Suction Line — Partially Restricted or Plugged (c)
Normal to Low	Normal	Fast	Short	Normal	Evaporator — Restricted Airflow
			Short to Very Short	Normal to Long	Condenser fixed orifice Tube or A/C Liquid Line — Partially Restricted or Plugged
			Short to Very Short	Short to Very Short	Low Refrigerant Charge
			Short to Very Short	Long	Evaporator Core — Partially Restricted or Plugged
Normal to Low	Low	Continuous Run			A/C Suction Line — Partially Restricted or Plugged (d) Clutch Cycling Switch — Sticking Closed
Low	Normal	Very Fast	Very Short	Very Short	Clutch Cycling Switch — Cycling Range Too Close
Erratic Operation or Compressor Not Running		—	—	—	Clutch Cycling Switch — Dirty Contacts or Sticking Open Poor Connection at A/C Clutch Connector or Clutch Cycling Switch Connector A/C Electrical Circuit Erratic — See A/C Electrical Circuit Wiring Diagram

## Additional Possible Cause Components Associated with Inadequate Compressor Operation

- Compressor Drive Belt — Loose
- Compressor Clutch — Slipping
- Clutch Coil Open — Shorted or Loose Mounting
- Control Assembly Switch — Dirty Contacts or Sticking Open
- Clutch Wiring Circuit — High Resistance Open or Blown Fuse

## Additional Possible Cause Components Associated with a Damaged Compressor

- Compressor Clutch — Seized
- Clutch Cycling Switch — Sticking Closed
- Suction Accumulator Drier — Refrigerant Oil Bleed Hole Plugged
- Refrigerant Leaks

(a) Compressor may make noise on initial run. This is slugging condition caused by excessive liquid refrigerant.

(b) Compressor clutch may not cycle in ambient temperatures above 80°F depending on humidity conditions.

(c) Low pressure reading will be normal to high if pressure is taken at accumulator and if restriction is downstream of service access valve.

(d) Low pressure reading will be low if pressure is taken near the compressor and restriction is upstream of service access valve.

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FIG. 11 Refrigerant System and Clutch Cycle Rate and Timing Evaluation—Fixed Orifice Tube Systems

## Special Flushing Equipment

Special refrigerant system flushing equipment is available from a number of air conditioning equipment manufacturers and usually comes in kit form.

The kit consists of a cylinder for the flushing agent, a nozzle to introduce the flushing agent into the system and a connecting hose (Fig. 13).

Another type of equipment which must be connected into the system allows for the continuous circulation of the flushing agent through the system with the contaminants being trapped by an external filter/drier. If

Refrigerant	Vaporizes @ °F	Approximate Closed Container Pressure @					Adaptability
		60°F	70°F	80°F	90°F	100°F	
R-12	-21.6°F	57 PSI	70 PSI	84 PSI	100 PSI	117 PSI	Self Propelling
F-114	38.4°F	8 PSI	13 PSI	19 PSI	25 PSI	32 PSI	
F-11	74.7°F	8 in Hg	3 in Hg	1 PSI	5 PSI	9 PSI	Pump Required*
F-113	117.6°F	22 in Hg	19 in Hg	16 in Hg	13 in Hg	8 in Hg	

\*F-11 is also available in pressurized containers. This makes it suitable for usage when special flushing equipment is not available. However, it is more toxic than R-12 and F-114.

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FIG. 12 Refrigerant Flushing Information Chart

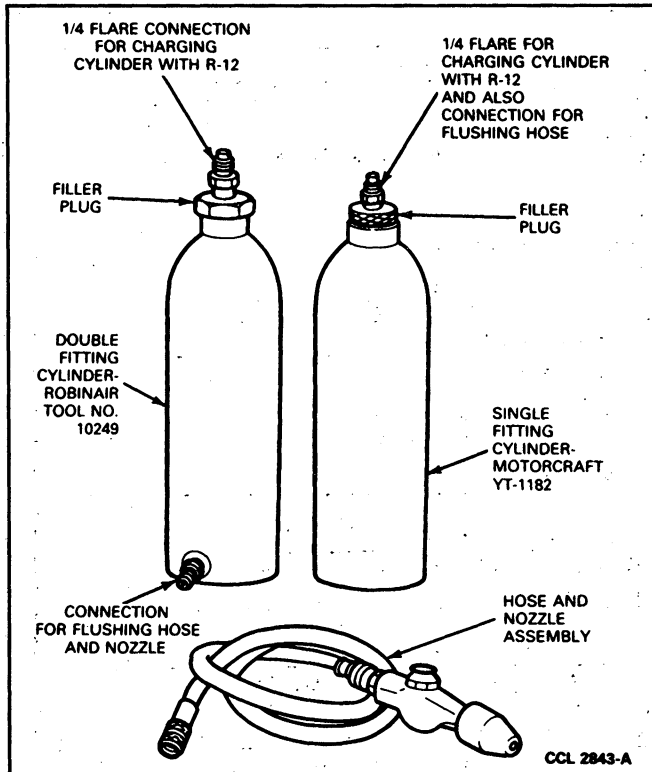


FIG. 13 Refrigerant System Flushing Kit

equipment other than a refrigerant system flushing kit is used, follow the manufacturer's instructions and safety precautions carefully.

### System Cleaning and Flushing

1. Check hose connections at flushing cylinder outlet and flushing nozzle to be sure they are tight.
2. Ensure flushing cylinder is filled with approximately 0.47L (1 pint) of Refrigerant-113. Ensure valve assembly in top of cylinder is tightened securely.
3. Connect a can of Refrigerant-12 to Schrader valve at top of charging cylinder. A refrigerant hose and a special safety-type refrigerants dispensing valve, such as Small Can Adapter 023-00009 (Motorcraft YT-280) or equivalent, are required for connecting small can to cylinder. Ensure valve on can is closed (full clockwise) when connections are made. Ensure all connections are tight.
4. Connect a gauge manifold and discharge the system. Disconnect gauge manifold.
5. Remove compressor from vehicle for cleaning and service or replacement, as required. If compressor

is cleaned and serviced, add specified amount of refrigerant oil prior to installing it in vehicle. Place protective caps on compressor inlet and outlet connections and install it on mounting brackets in vehicle. If compressor is replaced, adjust oil level. Refer to Section 36-39. Install the shipping caps on compressor connections. Install new compressor on mounting brackets in vehicle.

#### 6. For E-150—E-350 vehicles:

- a. Place a suitable container under removed discharge hose compressor manifold end. Back-flush the condenser and discharge hose from receiver-drier connection with a suitable flushing agent. Observe all safety precautions.
- b. Attach a short piece of hose to liquid line connection at receiver-drier and place end of hose in a suitable container to hold flushing agent.
- c. If vehicle has an auxiliary air conditioner, disconnect auxiliary liquid line from front system liquid line, and cap opening in front system line.
- d. Flush front system liquid line from expansion valve end with a suitable flushing solvent. Observe all safety precautions.
- e. If vehicle is equipped with an auxiliary air conditioner, disconnect auxiliary unit suction hose from front unit suction hose at spring lock coupling. Cover male fitting of spring lock coupling with a suitable plastic cap.
- f. Place a suitable container under removed suction hose compressor manifold end. Then, flush evaporator core and suction line from expansion valve connection with a suitable-flushing agent.
- g. Remove plastic cap from auxiliary unit suction line take-off and again flush suction line auxiliary system take-off hose.
- h. If vehicle is equipped with an auxiliary air conditioner, remove expansion valve from auxiliary evaporator core and liquid line. Clean expansion valve with a small charge of Refrigerant-113. Blow the Refrigerant-113 out with a small charge of Refrigerant-12. When installing the cleaned valve, use a new O-ring which has been dipped in clean refrigerant oil.
- i. Place a suitable container under engine end of auxiliary liquid line. Flush auxiliary liquid line from expansion valve end with a suitable flushing agent.



- j. Attach a piece of hose to auxiliary unit evaporator core inlet and place end of hose in a suitable container. Flush suction hose and evaporator core with a suitable flushing agent. Observe all safety precautions.
  - k. Purge all system components with nitrogen or liquid Refrigerant-12.
  - l. Assemble all connections using new O-rings lubricated with clean refrigerant oil. Use only specified O-rings on spring lock couplings.
  - m. Install a new receiver-drier using new O-rings lubricated with clean refrigerant oil. Tighten fittings to specifications using a backup wrench to prevent component damage.
7. For F-150—F-350—F-Super Duty and Bronco vehicles, remove suction accumulator/drier and discard. Install a new one and connect it to the evaporator. Do not connect it to suction line from compressor, but ensure protective cap is in place on suction line connection.
  8. Remove fixed orifice tube. If a new tube is available, replace contaminated one. Otherwise, wash it carefully in flushing refrigerant or mineral spirits and blow it dry. If it does not show signs of damage or deterioration, it may be reused. Be sure to use new O-rings dipped in clean refrigerant oil. Install a protective cap on evaporative inlet line, as soon as orifice tube is in place. The liquid line will be connected later.
  9. Back-flush the condenser and liquid line as follows:
    - a. Remove O-ring from condenser inlet tube "O" coupling.
    - b. Remove discharge hose from condenser and clamp a piece of heater hose (1/2 inch ID) to the condenser inlet line. Be sure hose is long enough to insert free end into a suitable waste container to catch the flushing refrigerant.
    - c. Move flushing equipment into position and open valve on can of Refrigerant-12 (fully counterclockwise).
    - d. Back-flush condenser and liquid line by introducing flushing refrigerant into supported end of liquid line with flushing nozzle. Hold nozzle firmly against open end of liquid line.
    - e. After liquid line and condenser have been flushed, lay charging cylinder on its side so that Refrigerant-12 will not force more flushing refrigerant into liquid line. Press nozzle firmly to liquid line and admit Refrigerant-12 to force all flushing refrigerant from liquid line and condenser.
    - f. Remove 1/2-inch hose and clamp from condenser inlet connection.
    - g. Stand flushing cylinder upright and flush compressor discharge line. Secure it so flushing refrigerant goes into waste container.
    - h. Close dispensing valve at Refrigerant-12 can (fully clockwise). If there is any flushing

refrigerant in cylinder, it may be left there until next flushing job. Put flushing kit and Refrigerant-12 can in a suitable storage location.

- i. Install new lubricated O-rings on tube-"O" coupling male fittings on both the condenser inlet and liquid lines. Assemble the couplings.
10. Connect all refrigerant lines. Connections should be cleaned and new O-rings used. Lubricate new O-rings with clean refrigerant oil. Any moisture in the evaporator will be removed during system evacuation.
  11. Connect a charging station or manifold gauge set and charge the system with 0.45kg (1 pound) of Refrigerant-12 (do not evacuate the system until after it has been leak tested).
  12. Leak test all connections and components with a flame-type or electronic leak detector. If no leaks are found, go to Step 13. If a leak(s) is found, service as necessary, recheck the system, and then go to Step 13.
  13. Evacuate and charge the system with the specified amount of Refrigerant-12. Operate the system to be sure it is cooling properly.

### Flushing The System With Special Flushing Equipment

Special refrigerant system flushing equipment is available from various air conditioning equipment manufacturers. This equipment provides a faster method of cleaning the major refrigerant system components without removing them from the vehicle. All restrictive components, however, such as the fixed orifice tube, the suction accumulator/drier, the expansion valve and the receiver/drier must be removed. A temporary replacement for the removed suction accumulator/drier or receiver/drier can be made by using tubing such as neoprene or plastic garden hose. This allows for the continuous circulation of a refrigerant system flushing agent so that all system contaminants can be washed out of the major refrigerant system components and hose assemblies, to be trapped in an external filter/drier assembly.

**CAUTION: Always check to be sure the flushing refrigerant is compatible with the hose material being used. Some hose materials may dissolve, swell or become brittle when used with certain refrigerants.**

The Safety Precautions should be observed at all times. If the components are flushed with a refrigerant other than R-12, it is necessary to remove the excess flushing refrigerant by blowing out with refrigerant-12 or with Nitrogen. If Nitrogen is used, a pressure regulator should be installed on the Nitrogen supply tank to reduce the extremely high Nitrogen Supply Pressure.

When cleaning a contaminated refrigerant system using the continuous circulation method, follow the method as recommended by the manufacturer of the special flushing equipment.

## Insufficient or No A/C Cooling Fixed Orifice Tube Cycling Clutch System

TEST STEP		RESULT	ACTION TO TAKE
<b>A1</b>	<b>VERIFY CONDITION</b>		
<ul style="list-style-type: none"> <li>Verify the condition.</li> </ul>		System cooling properly System not cooling properly	Instruct driver on how to use system. GO to A2.
<b>A2</b>	<b>CHECK A/C CLUTCH</b>		
<ul style="list-style-type: none"> <li>Does the A/C compressor clutch engage?</li> </ul>		Yes No	GO to A3. REFER to compressor clutch, circuit diagnosis.
<b>A3</b>	<b>CHECK UNDER HOOD</b>		
Under-hood check for: <ul style="list-style-type: none"> <li>Loose, missing or damaged compressor drive belt.</li> <li>Loose or disconnected A/C clutch or clutch cycling pressure switch wires or connectors.</li> <li>Disconnected resistor assembly.</li> <li>Loose vacuum lines or misadjusted control cables.</li> </ul> In-car check for: <ul style="list-style-type: none"> <li>Blown fuse/proper blower motor operation.</li> <li>Vacuum motors/temperature door movement — full travel.</li> <li>Control electrical and vacuum connections.</li> </ul>		OK but still not cooling Not OK	GO to A5. REPAIR and GO to A4.
<b>A4</b>	<b>CHECK SYSTEM OPERATION</b>		
<ul style="list-style-type: none"> <li>Check system operation.</li> </ul>		System cooling OK System not cooling OK	Condition corrected, GO to A1. GO to A5.

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## Insufficient or No A/C Cooling Fixed Orifice Tube Cycling Clutch System (Continued)

TEST STEP		RESULT	ACTION TO TAKE
<b>A5</b>	<b>CHECK PRESSURE/CLUTCH CYCLE RATE</b>		
<ul style="list-style-type: none"> <li>Use refrigerant system pressure/clutch cycle rate and timing evaluation charts.               <ol style="list-style-type: none"> <li>Hook up manifold gauge set.</li> <li>Set function lever at MAX A/C.</li> <li>Set blower switch on HIGH.</li> <li>Set temp lever full cold.</li> <li>Close doors and windows.</li> <li>Use a thermometer to check temperature at center discharge register. Record outside temperature.</li> <li>Run engine at approximately 1500 RPM with compressor clutch engaged.</li> <li>Stabilize with above conditions for 10-15 minutes.</li> </ol> </li> <li>Check compressor clutch OFF/ON; time with watch. See charts for normal clutch cycle and timing rates.</li> </ul>		Compressor cycles very rapidly	GO to A6.
		Compressor runs continuously (Normal operation in ambient temp above 26.6° (80°F) depending on humidity conditions)	GO to A7.
		Compressor cycles slow	GO to A6.
<b>A6</b>	<b>CHECK EVAPORATOR TUBES TEMP.</b>		
<ul style="list-style-type: none"> <li>Bypass clutch cycling pressure switch with jumper wire. Compressor on continuously.</li> <li>Hand feel evaporator inlet and outlet tubes.</li> </ul>		Outlet tube same temperature (Approximately -2.2°C- -4.4°C or 28°F-40°F) or slightly colder than inlet tube (after fixed orifice)	REPLACE expansion valve. GO to A7.
		Inlet tube warm or (after fixed orifice) colder than outlet tube	GO to A8.

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TEST STEP		RESULT	ACTION TO TAKE
<b>A7</b>	<b>CHECK PRESSURES</b>		
Check system pressures. • Compare readings with normal system pressure ranges.		Clutch cycles within limits	System OK. GO to A1.
		Compressor runs continuously (normal operation in ambient temperature above 26.6°C (80°F) depending on humidity conditions).	GO to A9.
		Compressor cycles high or low: ON above 358 kPa (52 psi) OFF below 144 kPa (21 psi)	REPLACE expansion valve.
			System OK, GO to A1.
			Not OK. GO to A8.
<b>A8</b>	<b>CHECK FOR LEAKS</b>		
Leak check system.		Leak found	Repair, discharge, evacuate and charge system.
			System OK, GO to A1.
		No leak found	Low refrigerant charge or moisture in system. Discharge, evacuate and charge system. System OK.

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## Insufficient or No A/C Cooling Fixed Orifice Tube Cycling Clutch System (Continued)

TEST STEP		RESULT	ACTION TO TAKE
<b>A9</b>	<b>CHECK CLUTCH CYCLING OFF</b>		
Disconnect blower motor wire and check for clutch cycling off at 144 kPa (21 psi) (suction pressure).		Clutch cycles off at 144 kPa (21 psi)	RECONNECT blower motor wire.
			System OK, GO to A1.
		Pressure falls below 144 kPa (21 psi)	REPLACE expansion valve.
			System OK, GO to A1.

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## COMPRESSOR CLUTCH CIRCUIT DIAGNOSIS

TEST STEP		RESULT	ACTION TO TAKE
<b>A1</b>	<b>CHECK SYSTEM OPERATION</b>		
	<ul style="list-style-type: none"> <li>• Turn blower switch On.</li> <li>• Depress A/C push-button.</li> <li>• Turn ignition switch to Run position.</li> <li>• Compressor clutch should engage.</li> </ul>	Clutch operates Clutch does not operate	System OK. GO to A2.
<b>A2</b>	<b>CHECK FOR VOLTAGE</b>		
	<ul style="list-style-type: none"> <li>• Check for voltage at circuit wire at the clutch cycling pressure switch connector or A/C control switch (E-150 — E-350).</li> </ul>	Voltage present No voltage	GO to A3. GO to A9.
<b>A3</b>	<b>BY-PASS PRESSURE SWITCH</b>		
	<ul style="list-style-type: none"> <li>• Disconnect connector at clutch cycling pressure switch or control switch (E-150 — E-350).</li> <li>• Jumper connector pins or control switch.</li> <li>• Clutch should engage.</li> </ul>	Not OK	GO to A4. GO to A5.
<b>A4</b>	<b>CHECK SYSTEM PRESSURE</b>		
	<ul style="list-style-type: none"> <li>• Connect manifold gauge set and check system pressure.</li> </ul>	Pressure above 55 psi Pressure below 55 psi (ambient temperature above 50°F)	REPLACE clutch cycling pressure switch. GO to A1. CHECK refrigerant system for leaks. REPAIR and CHARGE system as necessary GO to A1.
<b>A5</b>	<b>CHECK VOLTAGE AT CLUTCH</b>		
	<ul style="list-style-type: none"> <li>• Check for voltage at clutch field coil.</li> </ul>	Voltage present No voltage	GO to A8. GO to A7.
<b>A6</b>	<b>CHECK CLUTCH GROUND</b>		
	<ul style="list-style-type: none"> <li>• Jumper ground terminal of clutch field coil to ground.</li> <li>• Clutch should engage.</li> </ul>		SERVICE open in ground wire. GO to A1. REPLACE clutch field coil. GO to A1.
<b>A7</b>	<b>CHECK FUSE</b>		
	<ul style="list-style-type: none"> <li>• Check Fuse 17 in fuse panel for continuity.</li> </ul>		GO to A8. CHECK for short. SERVICE as necessary. REPLACE fuse. GO to A1.

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## COMPRESSOR CLUTCH CIRCUIT DIAGNOSIS — Continued

TEST STEP		RESULT	ACTION TO TAKE
<b>A8</b>	<b>CHECK A/C CONTROLS</b>		
		<ul style="list-style-type: none"> <li>• Move Function selector lever to DEFROST position.</li> <li>• Check for voltage at circuit wire at the clutch cycling pressure switch connector.</li> </ul>	Voltage present → GO to <b>A10</b> . No voltage → GO to <b>A9</b> .
<b>A9</b>	<b>CHECK CIRCUIT 294</b>		
		<ul style="list-style-type: none"> <li>• Remove connector from A/C push-button switch.</li> <li>• Check for voltage at circuit.</li> </ul>	Voltage present → GO to <b>A10</b> . No voltage → CHECK for open in Circuit 294. SERVICE as necessary. GO to <b>A1</b> .
<b>A10</b>	<b>CHECK A/C CONTROLS</b>		
		<ul style="list-style-type: none"> <li>• Check A/C push button switch and Function switch for continuity. <b>NOTE: A/C push-button switch must be depressed. Function switch must be in DEFROST position.</b></li> </ul>	Continuity through Function switch only → REPLACE A/C pushbutton switch. GO to <b>A1</b> . Continuity through A/C pushbutton switch only → REPLACE Function switch. GO to <b>A1</b> . Continuity through both switches → CHECK for open in circuit between control assembly and clutch cycling pressure switch. SERVICE as necessary. GO to <b>A1</b> .

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## SPECIFICATIONS

Rotunda Equipment	Model	Motorcraft
Flame Type Leak Detector	023-00006	YT-202
Dial Thermometer	023-00007	YT-227
Small Can Adapter	023-00009	YT-280
Manifold Gauge Set	063-00010	YT-201

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## REFRIGERANT CAPACITIES (REFRIGERANT-12)

Vehicle	Capacity (Pounds)
F-150 — F-350 and Bronco	3.00 + .25-0
E-150 — E-350	3-1/2 + .25-0 Front A/C Only
E-150 — E-350	4-1/4 + .25-0 Front and Auxiliary A/C

## REFRIGERANT SPECIFICATION

Type	Specification	Part No.
Refrigerant-12 (R-12) Dichlorodifluoromethane CCL <sub>2</sub> F <sub>2</sub>	ESA-M17B2-A or equivalent	D3AZ-19B519-A or equivalent

## SPECIAL SERVICE TOOLS

Description	Number	Motorcraft
Belt Tension Gauge	T63L-8620-A	YT-371
Straight Adapter	T71P-19703-S	—
Curved Adapter	T71P-19703-R	—
Back Flushing Adapter — E-150 — E-350, F-150 — F-350, Bronco	T83P-19703-B	YT-1123
Service Port Adapter	D81L-19703-A	—
Orifice Tube Remover and Installer	D80L-19990-A	YT-1008
Broken Orifice Tube Extractor	D80L-19990-B	YT-1009
Flexible Adapter	D81L-19703-C	YT-355
Straight Adapter	D81L-19703-D	YT-357
90 Degree Adapter	D81L-19703-B	YT-354
45 Degree Adapter	D81L-19703-E	YT-927
Spring Lock Coupling Tool 3/8 Inch	T81P-19623-G1	—
1/2 Inch	T81P-19623-G2	—
5/8 Inch	T83P-19623-C	—
3/4 Inch	T85L-19623-A	—
Tee Adapter	D87P-19703-A	①

① Also available from: Four Seasons P.N. 59655 and Robinair P.N. 40387.

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# SECTION 36-33 FX-15 Compressor and Clutch

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION .....	36-33-1	SPECIAL SERVICE TOOLS .....	36-33-7
MAINTENANCE		SPECIFICATIONS .....	36-33-7
Adding Refrigerant Oil .....	36-33-1	TESTING	
REMOVAL AND INSTALLATION		Compressor Internal Leak Test .....	36-33-2
Clutch Hub and Pulley .....	36-33-3	Compressor Manifold Leak Test .....	36-33-2
Manifold and Hose Assembly .....	36-33-2	Compressor Rotating Torque Check .....	36-33-2
Shaft Seal .....	36-33-4	VEHICLE APPLICATION .....	36-33-1

## VEHICLE APPLICATION

All Light Truck Vehicles with Gasoline Engines.

NOTE: Service parts except manifold hose O-rings, will not be available for the FX-15 Compressor until the 1990 model year. All FX-15 compressors requiring repair are to be replaced with a new compressor and clutch assembly.

## DESCRIPTION AND OPERATION

The FX-15 is a swash/plate design ten cylinder aluminum compressor utilizing the tangential design mount (Fig. 1). The compressor mainshaft is driven by a belt from the engine crankshaft pulley. A one-piece lip-type seal (replaceable from the front of the compressor) is used to seal the compressor at the shaft opening of the compressor assembly. Five double-acting pistons, positioned axially around the compressor shaft, operate within the cylinder assembly. The pistons are actuated by a swash/plate that is pressed on the compressor shaft. The swash/plate changes the rotating acting of the shaft to provide a reciprocating driving force to each of the five pistons. This driving force is applied, through shoes, to the midpoint of each of the double/ended pistons.

Reed-type discharge valves are assembled on the valve plate which is located with the suction reed valve between the cylinder assembly and the head at each end of the compressor. The heads are connected with each other by gas-tight passageways through the cylinder assembly which direct the refrigerant gas to the suction and discharge ports located in the rear head.

A magnetic clutch is used to drive the compressor shaft. When voltage is applied to the clutch field coil, the clutch plate and hub assembly (which is solidly coupled to the compressor shaft) is drawn rearward by magnetic force toward the pulley which rotates freely on the compressor front head casting. The magnetic force locks the clutch plate and hub assembly and the pulley together as one unit. The compressor shaft then turns with the pulley. When voltage is removed from the clutch field coil, springs in the clutch plate and hub assembly move the clutch plate away from the pulley, the clutch plate, hub assembly and compressor shaft cease to rotate.

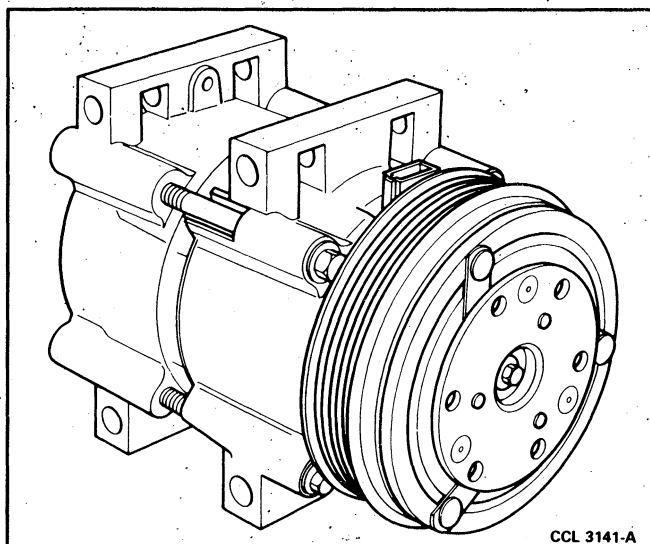


FIG. 1 FX-15 Compressor

## MAINTENANCE

### Adding Refrigerant Oil

The FX-15 compressor uses a unique high quality refrigerant oil. (Part Number E73Z-19577-A) Motorcraft Part Number YN-9 or an equivalent refrigerant oil meeting Ford specification ESH-M2C31-A2. An oil charge of 207ml (7 oz.) is required in a new system. It is extremely important that only the specified type and quantity of refrigerant oil be used in the FX-15 compressor. If there is a surplus of oil in the system, it will circulate with the refrigerant, reducing the cooling capacity of the system. Using too little oil or oil not meeting specification will result in poor lubrication of the compressor.

When it is necessary to replace a component of the refrigerant system, the procedures in this Section must be followed to ensure that the total oil charge in the system is correct after the new part is installed. When the compressor is operated, oil gradually leaves the compressor and is circulated through the system with the refrigerant. Eventually, a balanced condition is reached in which a certain amount of oil is retained in the compressor and a certain amount is continually circulated. If a component of the system is removed after the system had been operated, some oil will go with it. To maintain the original total oil charge, it is



necessary to compensate for this by replacing the oil in the new replacement part.

The procedures for replacing oil are as follows:

#### During Compressor Replacement

A new service replacement FX-15 compressor contains 207 ml (7 oz) of refrigerant oil. Prior to installing the replacement compressor, drain the refrigerant oil from the removed compressor into a calibrated container. Then, drain the refrigerant oil from the new compressor into a clean calibrated container. If the amount of oil drained from the removed compressor was between 90 and 148 ml (3 to 5 oz), pour the same amount of clean refrigerant oil into the new compressor. If the amount of oil that was removed from the oil compressor is greater than 148 ml (5 oz) pour 148 ml (5 oz) of clean refrigerant oil into the new compressor. If the amount of refrigeration oil that was removed from the old compressor is less than 90 ml (3 oz), pour 90 ml (3 oz) of clean refrigerant oil into the new compressor.

NOTE: The suction/accumulator-drier and orifice tube should also be replaced whenever the compressor is replaced.

#### During Component Replacement

When replacing other components of the air conditioning system, measured quantities of the specified refrigerant oil should be added to the component to ensure that the total oil charge in the system is correct before the system is operated.

Clean refrigerant oil should be added to the replacement components as follows:

- **Evaporator Core:** Add 90 ml (3 oz).
- **Condenser:** Add 30 ml (1 oz).
- **Accumulator:** Drain oil from removed accumulator/drier. Add same amount plus 30 ml (1 oz) of clean refrigerant oil to new accumulator.

Clean refrigerant oil should be poured directly into the replacement component.

If any other components such as an orifice tube or a hose is replaced, no additional refrigerant oil is necessary unless a hose bursts with a fully charged system. Then, the addition of refrigerant oil may be necessary with the amount to be determined by the technician. The suction/accumulator-drier should also be replaced under these circumstances.

### TESTING

#### Compressor Manifold Leak Test

1. Tighten the manifold retaining bolt to 18-23 N·m (13-17 ft-lb).
2. Add refrigerant to the system if necessary.
3. Leak test the manifold O-ring seals using a propane or electronic type leak detector. Refer to Section 36-30 Air Conditioning General Service for operating instructions and safety precautions when using a propane leak detector.
4. If no leaks are found, the manifold O-rings seals are good.
5. If a leak is found at the manifold and the manifold attaching bolt is tightened to 18-23 N·m (13-17 ft-lb), install new manifold O-ring seals as outlined. Then, repeat the leak test.

#### Compressor Internal Leak Test

1. If the compressor is on the vehicle, discharge the system following the recommended service procedure.
2. Remove the manifold attaching bolt and remove the manifold from the rear head of the compressor. Install Pressure Test Fitting Tool T89P-19623-H or equivalent on the rear head of the compressor using the existing manifold attaching bolt.
3. Connect the high and low pressure lines of a manifold gauge set to the corresponding fittings on the Manifold Pressure Test Fitting Tool (Fig. 2).
4. Attach the center hose of the manifold gauge set to a refrigerant container standing in an upright position.
5. Open the low pressure gauge valve, the high pressure gauge valve and the valve on the refrigerant container to allow the refrigerant vapor to flow into the compressor.
6. Using a propane type leak detector, check for leaks at the compressor shaft seal and the compressor center seal. Refer to "Checking For Leaks" in Section 36-30 Air Conditioning General Service for the operating instructions and safety precautions when using a propane type leak detector.
7. If a shaft seal leak is found, install a new shaft seal following the procedure given in this Section. If an external leak is found at the center joint of the compressor, install a new compressor assembly.

#### Compressor Rotating Torque Check

The rotational torque of a used compressor should be checked if excessive compressor drag is suspected.

1. Discharge refrigerant system following recommended service procedures. Observe all safety precautions.
2. Remove refrigerant hose manifold from compressor. Use care not to allow dirt to enter compressor.
3. With compressor clutch disengaged, rotate compressor clutch shaft and note the torque while rotating the compressor shaft, not the starting torque.
4. If the rotational torque exceeds specification, replace the compressor assembly.
5. If the rotational torque is less than the specified rotational torque, excessive drag does not exist in the compressor. Install the hose manifold and leak test, evacuate and charge the system.
6. Check the system for proper operation.

### REMOVAL AND INSTALLATION

#### Manifold and Hose Assembly

##### Removal

1. Discharge the refrigerant from the system following the recommended procedures. Remove bolt attaching manifold and hose/tube assembly to the rear head of the compressor (Fig. 3).
2. Disconnect other ends of suction and discharge lines. Remove any bracket attachments and

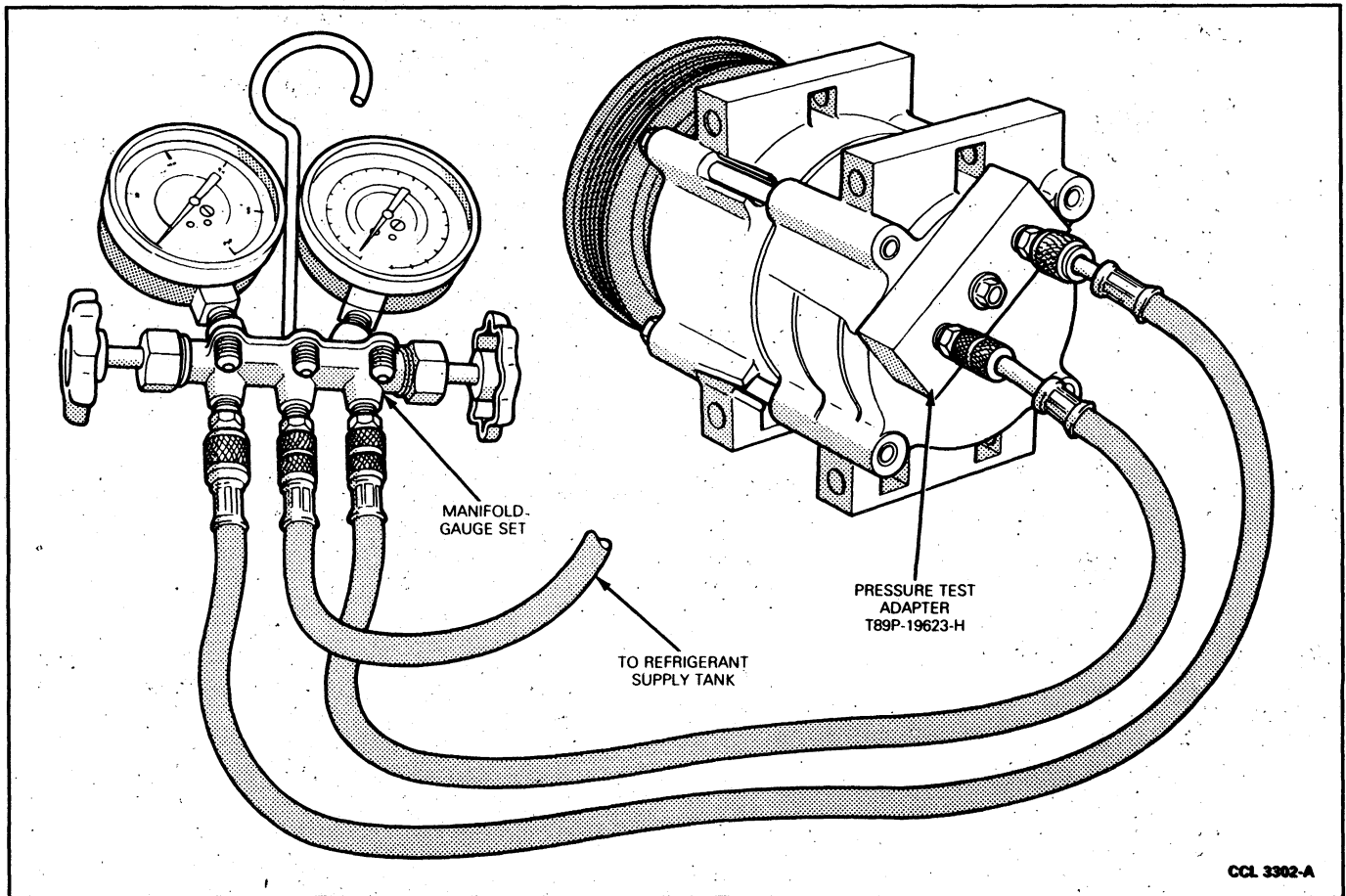


FIG. 2 Compressor Leak Test

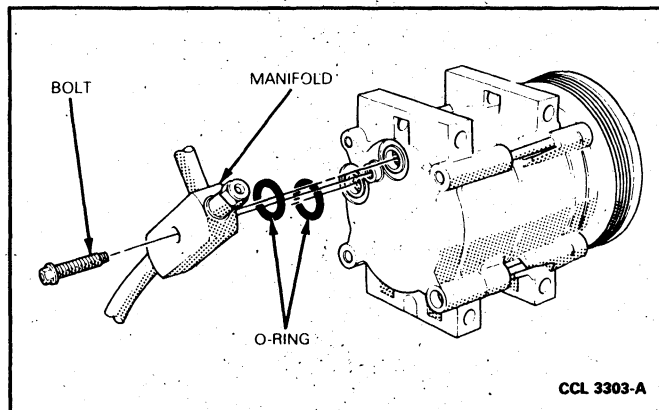


FIG. 3 Manifold Exploded From Compressor

remove manifold and hose/tube assembly from vehicle.

### Installation

1. Lubricate new O-rings with clean refrigerant oil and position them in the O-ring grooves of the compressor rear head (Fig. 3).
2. Position manifold and hose/tube assembly to rear head of compressor making sure manifold pilots are positioned in compressor port openings. Install manifold attaching bolt and tighten bolt to specification.

3. Connect other ends of suction and discharge lines using new lubricated O-rings. Install bracket attachments removed during removal.
4. Leak test, evacuate and charge the system following the recommended procedures. Observe all safety precautions.

### Clutch Hub and Pulley

An exploded view of the clutch assembly and related parts is shown in Fig. 4.

### Removal

1. Remove the clutch hub retaining bolt. Use Spanner Wrench T70P-4067-A or equivalent (Fig. 5).
2. Pull clutch hub and shims from compressor shaft. If hub cannot be pulled from compressor shaft, screw an 8 mm bolt into the shaft hole of the clutch hub to force the hub from the shaft (Fig. 6).
3. Remove the pulley retaining snap ring (Fig. 7).
4. Pull the pulley and bearing assembly from compressor.

### Installation

1. Clean pulley bearing surface of compressor head to remove any dirt or corrosion.
2. Install pulley and bearing assembly on compressor. The bearing is a slip fit on the compressor head and if properly aligned, it should slip on easily.
3. Install pulley retaining snap ring with bevel side of snap ring out.

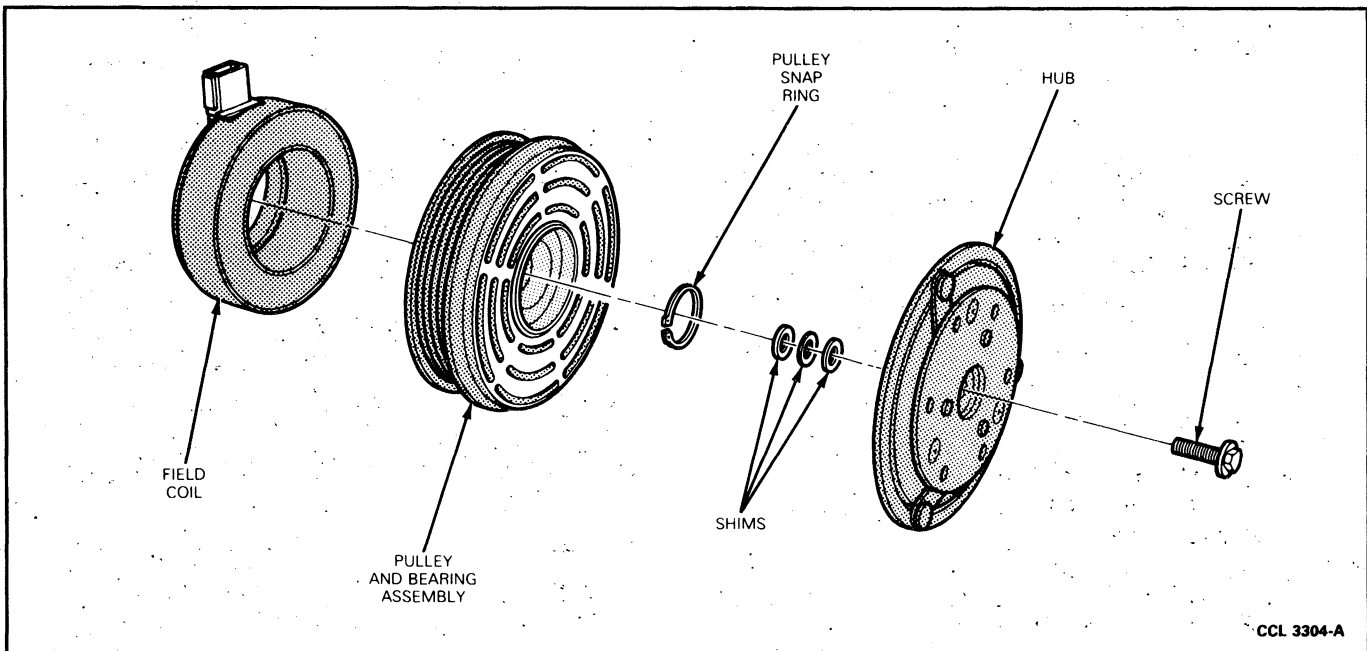


FIG. 4. Clutch Exploded View

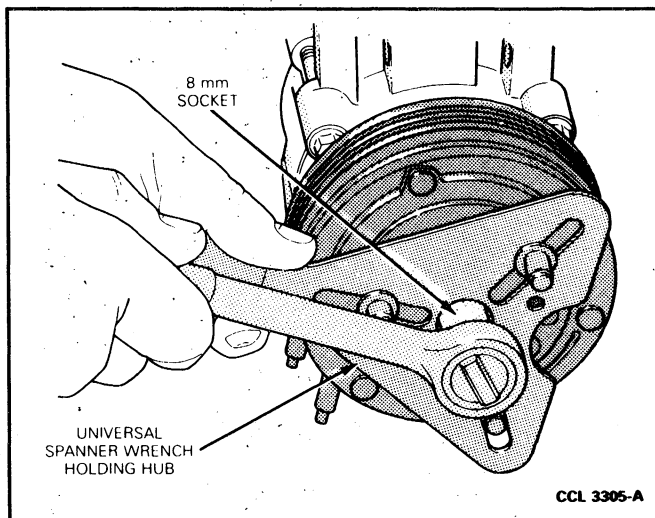


FIG. 5 Removing Clutch Hub Retaining Bolt

4. Place one nominal thickness spacer shim inside the hub spline opening and slide the hub on the end of compressor shaft.
5. Thread a new hub retaining bolt into end of compressor shaft. Tighten hub retaining bolt to 11-13 N·m (8-10 ft-lb) DO NOT USE AIR TOOLS.
6. Check clutch air gap between clutch hub and pulley mating surfaces with a feeler gauge (Fig. 8). The air gap should be between 0.45 and 0.85 mm (0.018 and 0.033 inch). Check at three locations equally spaced around the pulley.
7. If clutch air gap is not within 0.45 to 0.85 mm (0.018 to 0.033 inch), repeat steps 4 through 6 with various thickness shims until air gap is within specified limits.

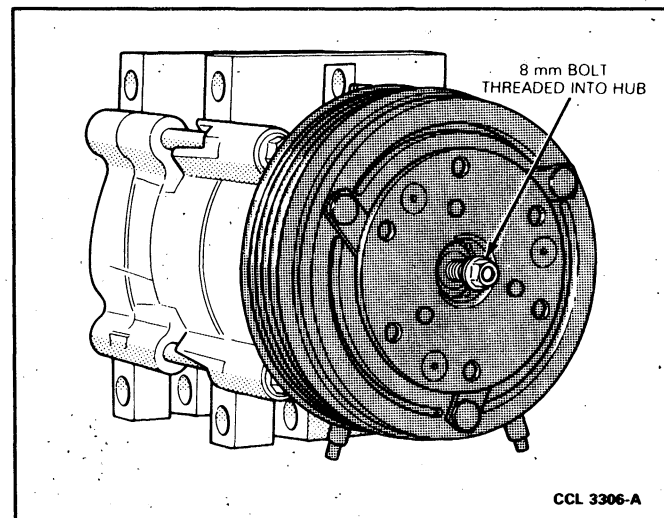


FIG. 6 Removing Clutch Hub with 8 mm Bolt

### Shaft Seal

The refrigerant system must be discharged and the compressor must be removed from the vehicle prior to replacing the compressor shaft seal.

### Removal

1. Remove clutch hub from compressor as outlined.
2. Remove shaft seal felt from hose of compressor with O-ring Tool T71P-19703-C or equivalent (Fig. 9).
3. Clean inside and outside hose area of compressor to remove excess oil and dirt.
4. Remove shaft seal retaining snap ring from inside compressor hose with snap ring pliers.
5. Position Shaft Seal Remover Tool T89P-19623-BH or equivalent over compressor shaft and push tool into hose of compressor and down against shaft seal. Engage end of tool with internal diameter of

shaft seal and turn tool handle clockwise to expand tool tip inside seal inner radius. Then, pull shaft seal from the compressor with tool (Fig. 10).

#### Installation

1. Inspect Shaft Protector Tool T39P-19623-CH for any burrs or damage to edge of the large end of the tool (Fig 11). Do not use tool if it is damaged.
2. If tool is not damaged, lubricate it with clean refrigerant oil.
3. Dip shaft seal in clean refrigerant oil and position seal over the shaft protector, making sure lip portion of the seal is pointed toward compressor (Fig. 12).
4. Using Shaft Seal Installer Tool T89P-19623-AH or equivalent, slowly push seal down shaft protector onto compressor shaft until seated (Fig. 18).
5. Remove replacer tool and shaft protector tool from compressor shaft.
6. Install seal retaining snap ring with snap ring pliers. Push snap ring against seal with Seal Installer Tool T89P-19623-AH or equivalent to seat snap ring in groove.
7. Leak test compressor as outlined under Compressor Internal Leak Test.
8. Install a new shaft seat felt in hose of compressor.
9. Install clutch hub on compressor as outlined.

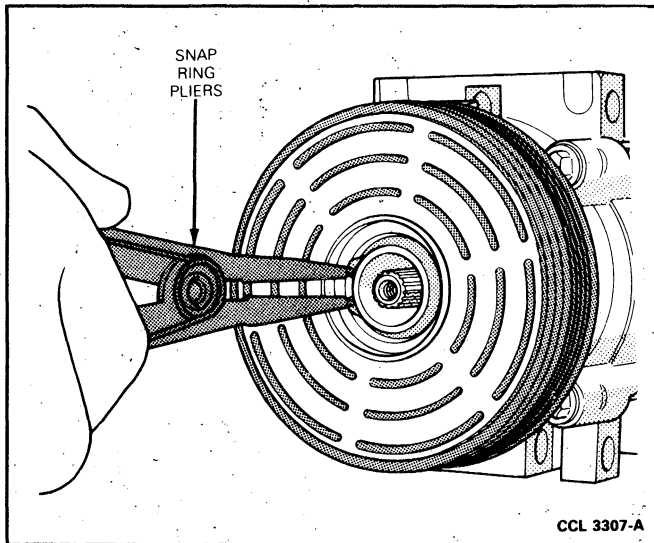


FIG. 7 Removing Pulley Retaining Snap Ring

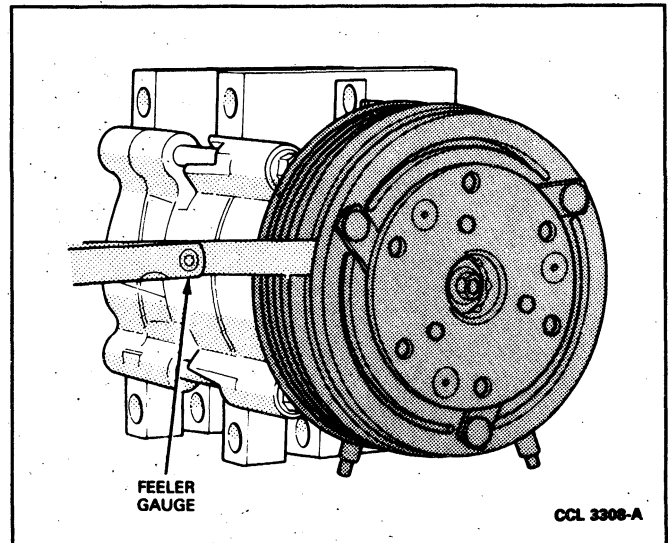


FIG. 8 Checking Clutch Air Gap

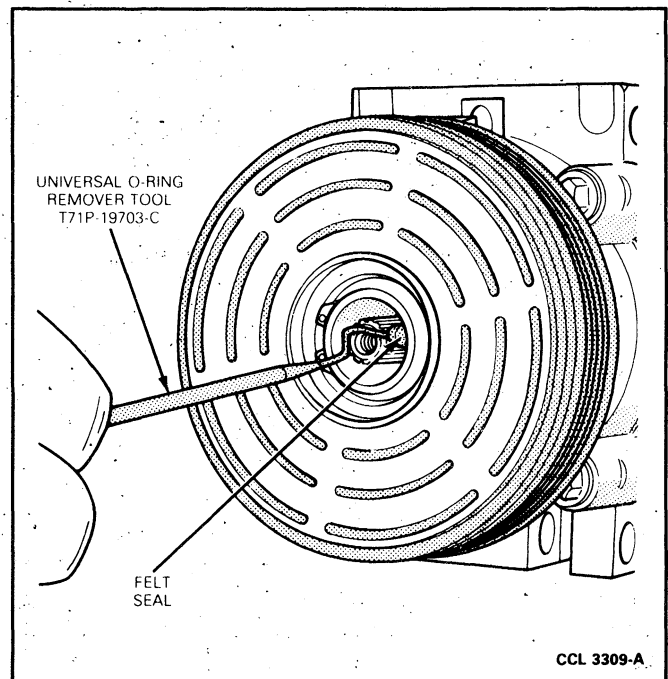


FIG. 9 Removing Shaft Felt Seat

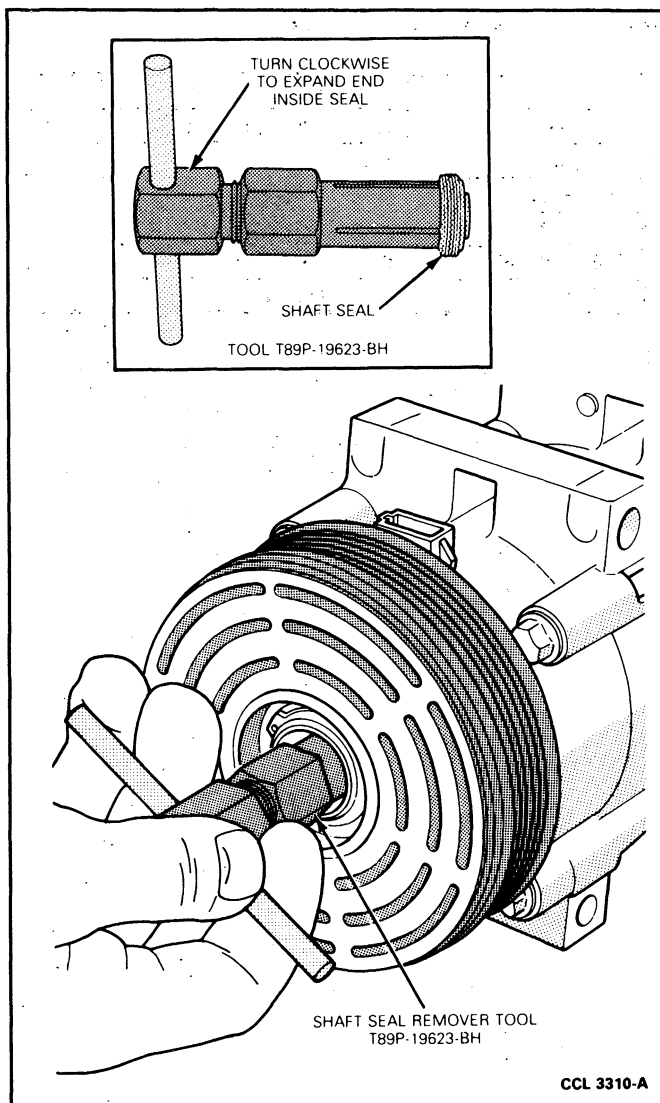


FIG. 10 Removing Shaft Seal

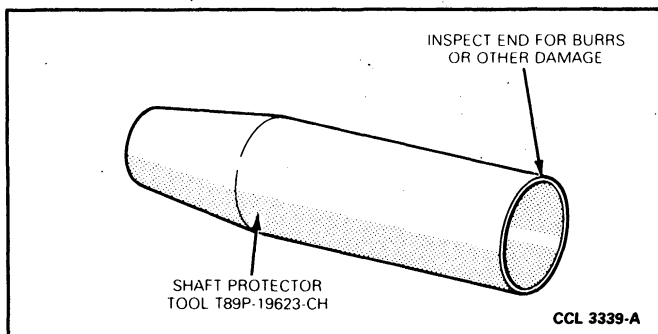


FIG. 11 Checking Shaft Seal Protector for Damage

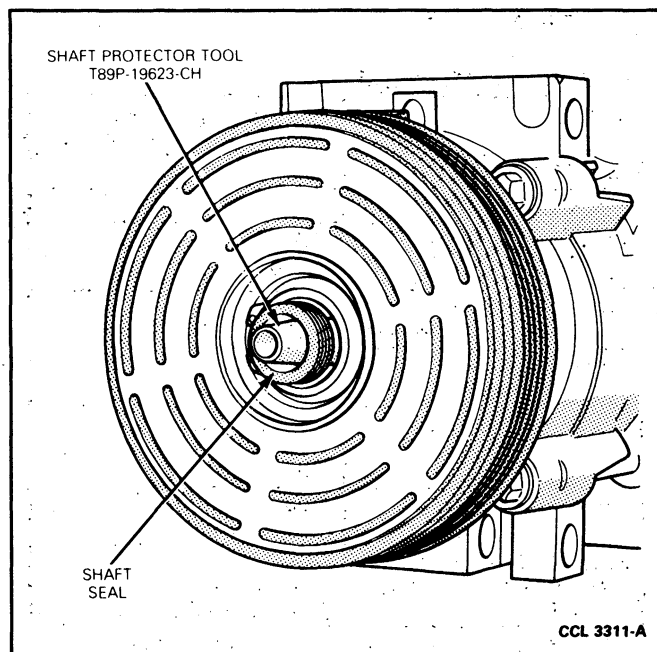


FIG. 12 Shaft Seal Protector Tool on Compressor Shaft

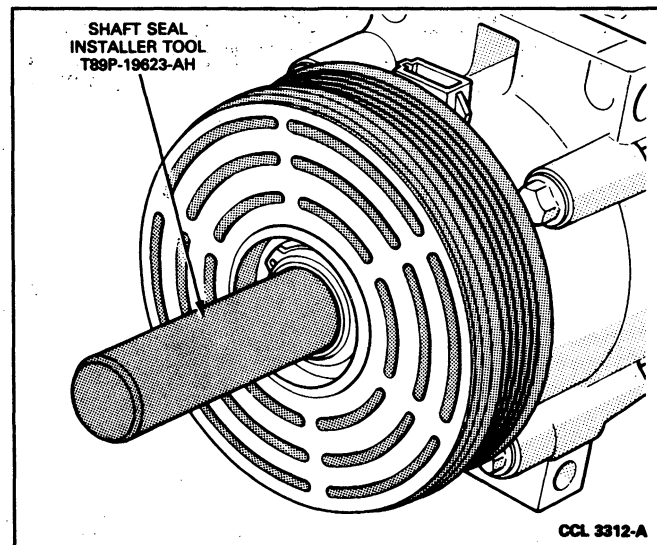


FIG. 13 Installing Shaft Seal

## SPECIFICATIONS

## COMPRESSOR SPECIFICATIONS

TYPE	SWASHPLATE, 5 DOUBLE ACTING PISTONS — AXIAL TYPE
DISPLACEMENT	10.4 CID (170cc)
CYLINDER BORE (Dia.)	29.0 mm
STROKE	25.7 mm
ROTATION	CLOCKWISE
ROTATIONAL TORQUE (Maximum, manifold removed)	10 Nm — (7 Ft-Lb)
REFRIGERANT OIL Ford Specification	ESH-M2C31-A2
Capacity (System Total)	207 ml (7 ounces) 295 ml (10 ounces) with auxiliary A/C
Part Number	E73Z-19577-A Motorcraft YN-9
MAGNETIC CLUTCH Air Gap Between Pulley and Hub	0.45 mm-0.85 mm (0.018-0.033 inch.)
Current Draw	4.36 Amps @ 12.8 volts
Run-Out (Maximum)	0.02 inch-Radial or Axial
TORQUE LIMITS Hose & Manifold Assy. to Compressor	17.5-23.0 Nm (17 Ft-Lb)
Clutch Hub Bolt	11.0-14.0 Nm (8-10 Ft-Lb)

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## SPECIAL SERVICE TOOLS

Tool Number	Description
T89P-19623-H	Pressure Test Fitting Tool
T70P-4067-A	Spanner Wrench
T71P-19703-C	O-Ring Tool
T89P-19623-BH	Shaft Seal Remover Tool
T89P-19623-CH	Shaft Protector Tool
T89P-19623-AH	Seal Installer Tool

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## SECTION 36-36 Compressor and Clutch—6E171

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION .....	36-36-1	REMOVAL AND INSTALLATION (Cont'd)	
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Adding Refrigerant Oil .....	36-36-1	Pulley Bearing .....	36-36-5
During Component Replacement .....	36-36-2	Suction or Discharge Manifold From	
During Compressor Replacement .....	36-36-2	Compressor .....	36-36-3
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### VEHICLE APPLICATION

Econoline and F-Series with 7.3L Diesel.

### DESCRIPTION AND OPERATION

The Nippondenso 6E171 compressor (Fig. 1) is a belt driven six-cylinder axial compressor with a displacement of 171 cc (10.4 cu-in). The compressor is attached to the engine's compressor mounting bracket by four legs on the bottom of the compressor and one support arm on the top of the compressor. Steel manifold and tube assemblies attach to the top ports of the compressor to connect the compressor to the refrigerant system.

Three double-acting pistons, positioned axially around the compressor shaft, operate in a front and rear cylinder assembly. The pistons are actuated by a swash-plate that is pressed on the compressor shaft. The swash plate changes the rotating action of the shaft to provide a reciprocating driving force to each of the three pistons. This driving force is applied, through shoes and balls, to the midpoint of each of the double ended pistons.

Reed-type suction and discharge valves are mounted in valve plates between the cylinder assembly and the head at each end of the compressor. The heads are connected with each other by gas tight passageways which direct refrigerant gas to a common output.

A magnetic clutch is used to drive the compressor shaft. When voltage is applied to the clutch field coil, the clutch plate and hub assembly (which is solidly coupled to the compressor shaft) is drawn by magnetic force toward the pulley which rotates freely on the compressor front head casting. The magnetic force locks the clutch plate and hub assembly and the pulley together as one unit. The compressor shaft then turns with the pulley. When voltage is removed from the clutch field coil, a rubber bushing in the clutch plate and hub assembly moves the clutch plate away from the pulley and the clutch plate and hub assembly and the compressor shaft cease to rotate.

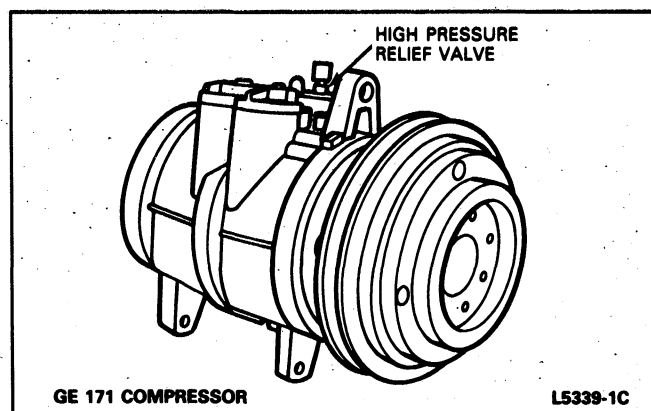


FIG. 1 Compressor and Clutch Assembly

### MAINTENANCE

#### Adding Refrigerant Oil

The 6E171 compressor uses a paraffin base refrigerant oil E73Z-19577-A or Motorcraft YN-9 or equivalent. An oil change of 300ml (10 fluid ounces) is required in a new system. It is important that only the specified type and quantity of refrigerant oil be used in the compressor. If there is a surplus of oil in the system, too much oil will circulate with the refrigerant, reducing the cooling capacity of the system. Too little oil will result in poor lubrication of the compressor.

When it is necessary to replace a component of the refrigerant system, the procedures given here must be followed to assure that the total oil charge in the system is correct after the new part is installed. When the compressor is operated, oil gradually leaves the compressor and is circulated through the system with the refrigerant. Eventually a balanced condition is reached in which a certain amount of oil is retained in the compressor and a certain amount is continually circulated. If a component of the system is removed after the system has been operated, some oil will go with it. To maintain the original total oil charge, it is necessary to compensate for this by replacing the oil in the new replacement part.

The procedures for replacing oil are as follows:

## During Compressor Replacement

A new service replacement compressor contains 300ml (10 fluid ounces) of the specified refrigerant oil. Prior to installing the replacement compressor, drain four fluid ounces of refrigerant oil from the compressor. This will maintain the system total oil charge within the specified limits.

## During Component Replacement

When replacing other components of the air conditioning refrigerant system, measured quantities of E73Z-19577-A or equivalent refrigerant oil should be added to the component to assure that the total oil charge in the system is correct before the system is operated.

Clean refrigerant oil should be added to the replacement components as follows:

- **Evaporator Core:** Add 88.71ml (3 fluid ounces).
- **Condenser:** Add 29.57ml (1 fluid ounce).
- **Receiver/Drier:** Drain the oil from the removed receiver/drier. Add the same amount plus 29.57ml (1 fluid ounce) of clean refrigerant oil to the new receiver/drier.

Clean refrigerant oil should be poured directly into the replacement component.

If any other components, such as valves or hoses are replaced, no additional refrigerant oil is necessary.

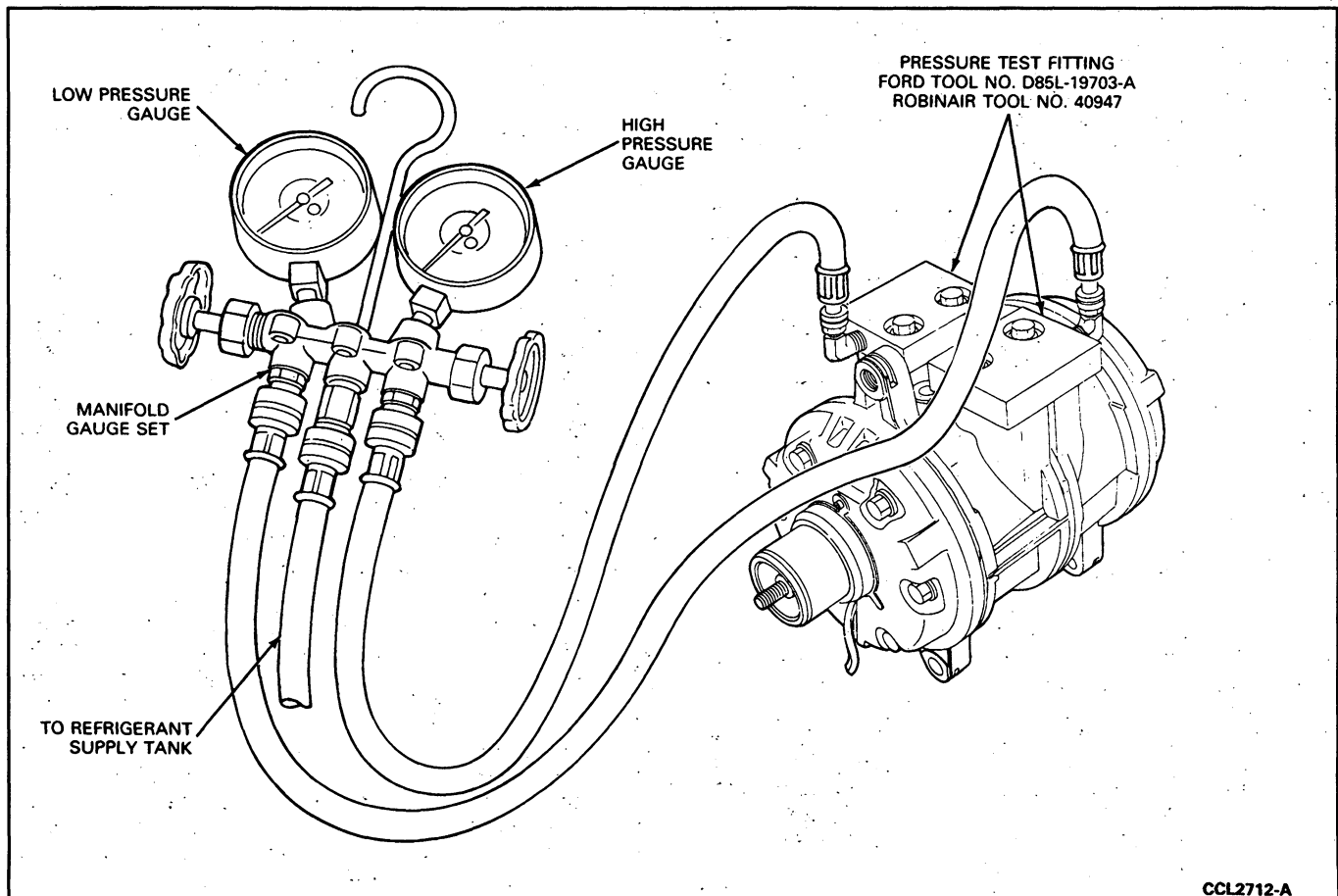
## TESTING

### Compressor Manifold Leak Test

1. Tighten the manifold retaining bolts to 18-23 N·m (13-17 ft-lb).
2. Leak test the manifold O-ring seals.
3. If no leaks are found during the leak test, the manifold O-ring seals are good.
4. If a leak is found at the manifold and the manifold bolts are tightened to 18-23 N·m (13-17 ft-lb), install new manifold O-ring seals and repeat the leak test procedure. Refer to manifold removal and installation procedure.

### Compressor External Leak Test

1. Discharge the system and remove the compressor from the vehicle.
2. Install the Pressure Test Plates D85L-19703-A or equivalent, on the compressor.
3. Connect the high and low pressure lines of a manifold gauge set to the corresponding fittings on the manifold pressure test plate (Fig. 2).
4. Attach the center hose of the manifold gauge set to a refrigerant drum standing in an upright position.
5. Open the low pressure gauge valve, the high pressure gauge valve, and the valve on the refrigerant drum to allow the refrigerant vapor to flow into the compressor.



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FIG. 2 External Leaks—Testing



6. Using a leak detector, such as Rotunda Electronic Leak Detector 055-00015 or equivalent, check for leaks at the compressor rear head seal, compressor front head seal, the compressor shaft seal, the center joint seal and around the cylinder bolt heads. After checking, turn off the manifold gauge valves.
7. If an external leak is found at either head, either manifold or at the shaft seal, service as necessary. If an external leak is found at the center joint of the compressor body, install a new compressor assembly.
8. If a refrigerant leak is found around the head of a cylinder bolt, install a new brass washer on the bolt and leak test as outlined. If the leak cannot be corrected with a new brass washer, install a new cylinder bolt and brass washer.
9. Disconnect the manifold gauge hoses from the pressure test plate.
10. Install the compressor on the vehicle. Leak test the installation, evacuate and charge the system.

### Compressor Rotating Torque Check

The rotational torque of a used compressor should be checked if excessive compressor drag is suspected.

1. Discharge the refrigerant system following the recommended service procedures. Observe all safety precautions.
2. Remove the compressor from the vehicle.
3. Rotate the compressor shaft and note the torque required for one complete rotation. Observe the torque while rotating the compressor shaft, not the starting torque.
4. If the rotational torque exceeds specification, replace the compressor assembly.
5. If the rotational torque is less than the specified rotational torque, excessive drag does not exist in the compressor. Install the compressor. Then, leak test, evaluate and charge the system.
6. Check the system for proper operation.

## REMOVAL AND INSTALLATION

### Suction or Discharge Manifold From Compressor

Each manifold assembly is an integral part of the refrigerant hose and/or tube. If it is necessary to replace a manifold, the attached hose and/or tube must also be replaced.

#### Removal

1. Discharge the refrigerant from the system following the recommended procedure.
2. Remove the two bolts attaching the manifold to the compressor and remove the manifold and O-rings (Fig. 3).
3. When replacing the discharge manifold, disconnect the other end of the discharge refrigerant line. Then, remove the refrigerant line and manifold from vehicle.
4. When replacing the suction manifold, disconnect the other end of the suction refrigerant line.

#### Installation

1. Lubricate the new O-rings with clean refrigerant oil and position them in the O-ring grooves of the manifold.
2. Apply Loctite sealer to the threads of the new manifold attaching bolts.
3. Position the manifold with O-rings to the compressor and install the two attaching bolts. Tighten the bolts to specification.
4. Connect the other end of the manifold and hose assembly.
5. Leak test, evacuate and charge the system following the recommended procedures. Observe all safety precautions.

### Clutch Hub and Pulley

#### Removal

1. Remove the clutch retaining nut. Use Spanner Wrench T81P-19623-MH or equivalent, if necessary (Fig. 4).
2. Remove the clutch hub and shims from the compressor shaft with Hub Remover T80L-19703-B or equivalent (Fig. 5). Hold the tool with a

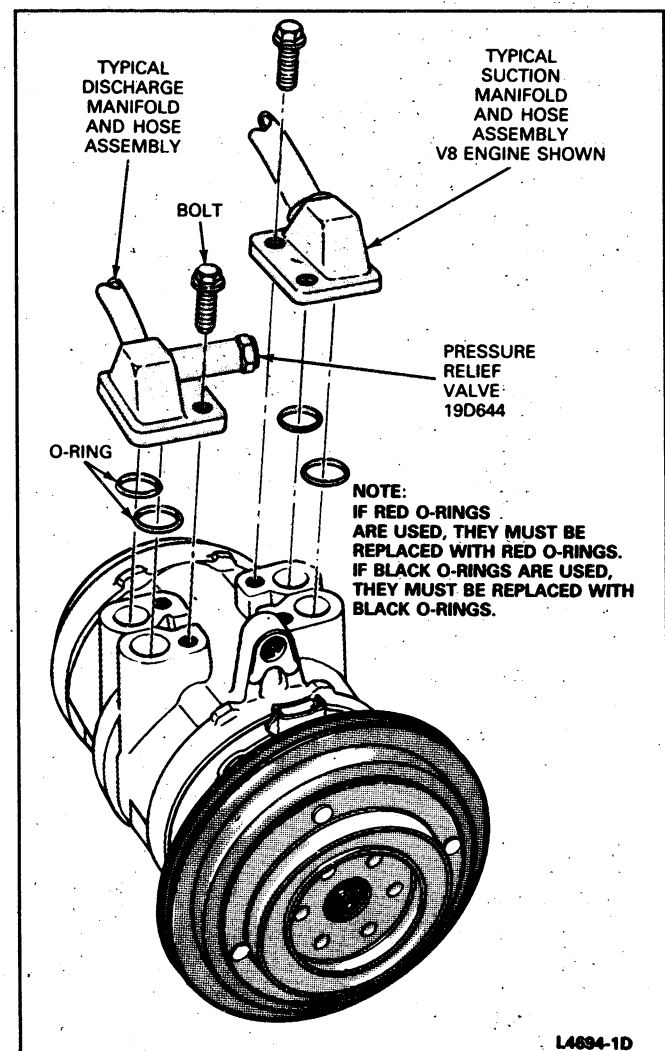


FIG. 3 Suction and Discharge Manifolds—Installation

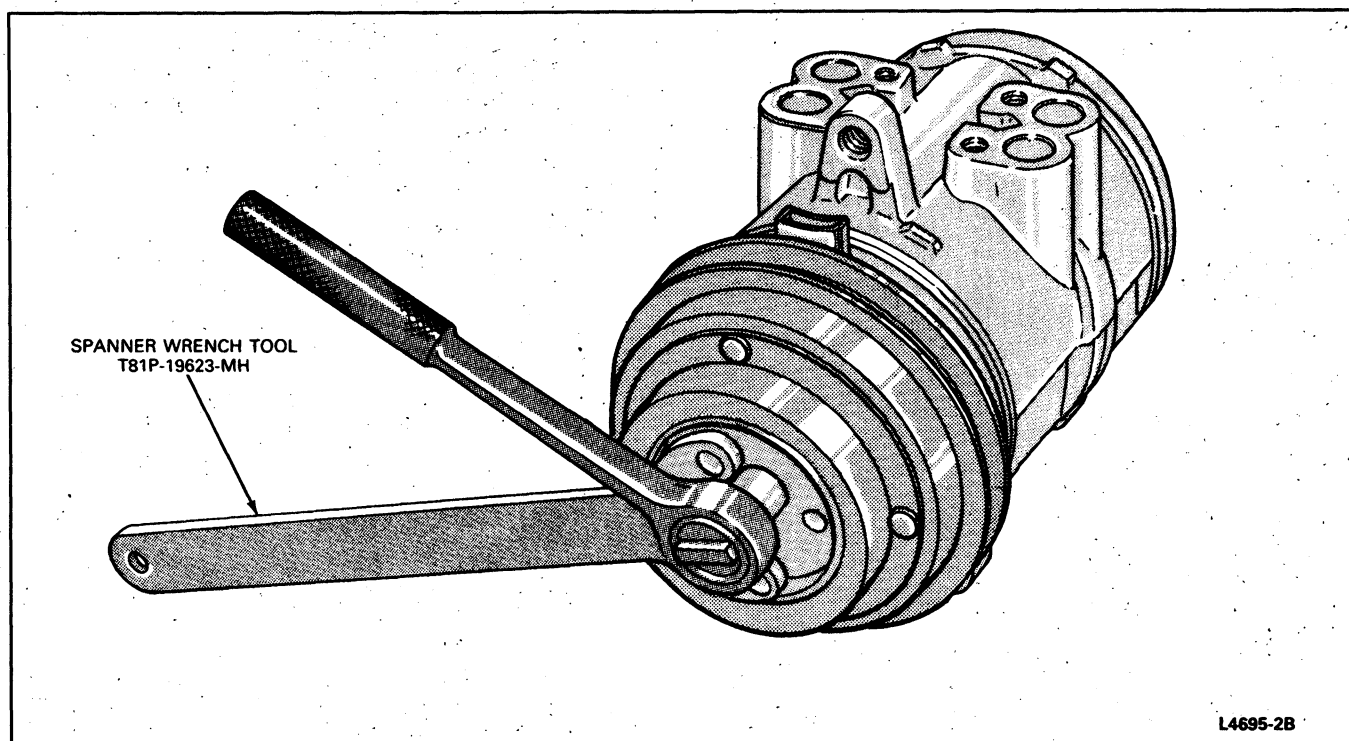


FIG. 4 Clutch Hub Retaining Nut—Removal

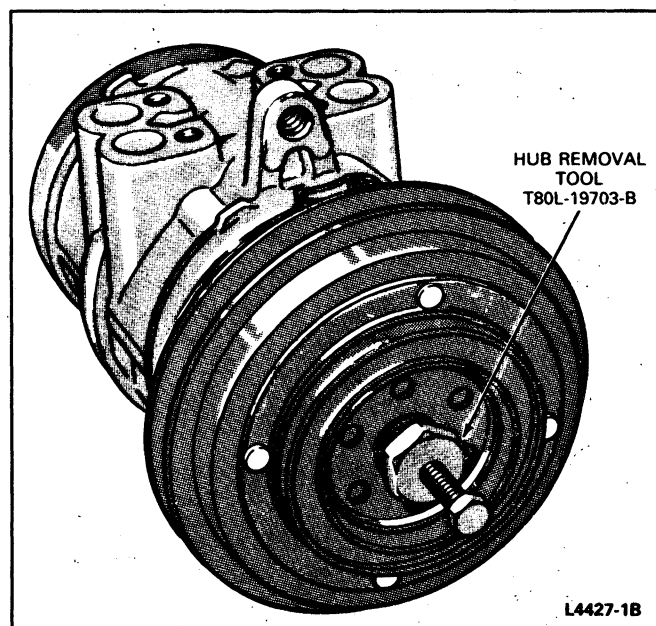


FIG. 5 Clutch Hub—Removal

1-inch wrench and tighten the bolt with a 1/2-inch wrench to pull the hub from the compressor shaft.

3. Remove clutch pulley retaining snap ring (Fig. 6).
4. Pull the pulley and bearing assembly from the compressor. If the pulley and bearing assembly cannot be removed by hand, use Compressor Shaft Protector T80L-19703-G and Pulley Puller D81P-19703-B or equivalent, to remove pulley (Fig. 7).

#### Installation

1. Clean the pulley bearing surface of the compressor head to remove any dirt or corrosion.
2. Install the pulley and bearing on the compressor. The bearing is a slip fit on the compressor head and, if properly aligned, should slip on the compressor head. If difficulty is encountered installing the pulley, gently tap the pulley on the compressor using Pulley Replacer T80L-19703-J or equivalent, (Fig. 8). **Be sure the pulley bearing is aligned with the compressor head.**
3. Install the pulley retaining snap ring with the bevel side of the snap ring out.
4. Install the clutch hub on the compressor shaft using the two thickest shims of the shim pack between the clutch hub and the end of the compressor shaft. Be sure the shaft key is aligned with the keyway in the clutch hub. Use Hub Replacer T80L-19703-F or equivalent to press the hub on the compressor shaft if necessary (Fig. 8). **Do not attempt to drive the hub on the compressor shaft as damage to the compressor will result.** Use only the specified tool if the hub will not easily slide on the compressor shaft.
5. Install the hub retaining nut on the compressor shaft and tighten the nut to specification.
6. Check the air gap between the hub and the mating pulley surface in three locations equally spaced around the pulley (Fig. 10). Record the air gap readings.
7. Rotate the compressor pulley one-half turn (180 degrees) and again check the air gap in three equally spaced locations. The smallest air gap must be within the specified limits for the air gap. Add or remove shims between the hub and the

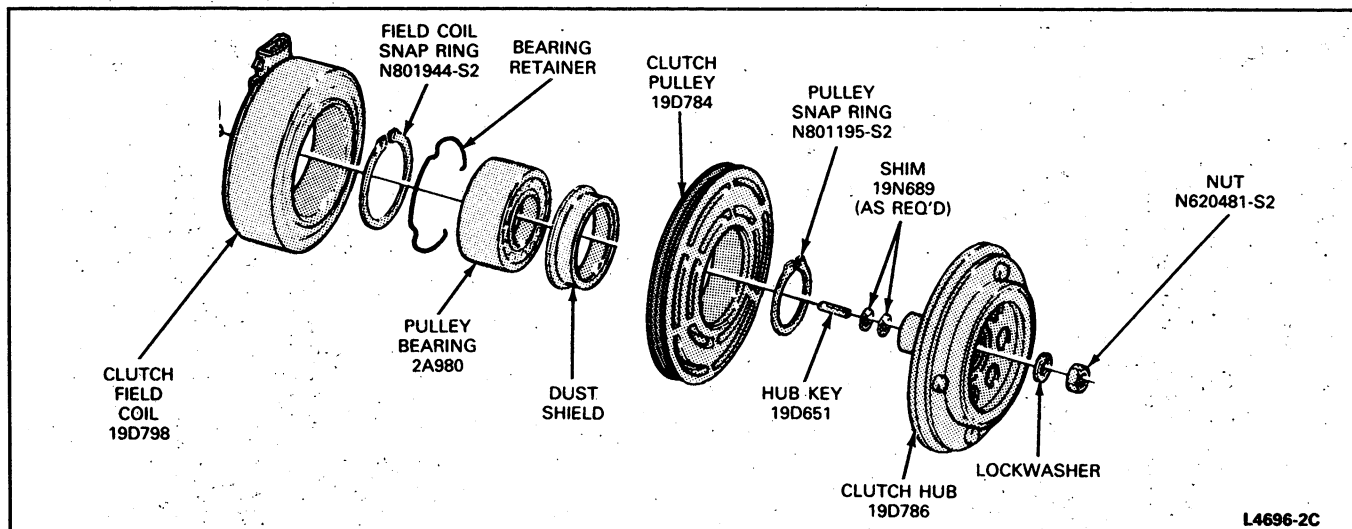


FIG. 6 Nippondenso Clutch Disassembled

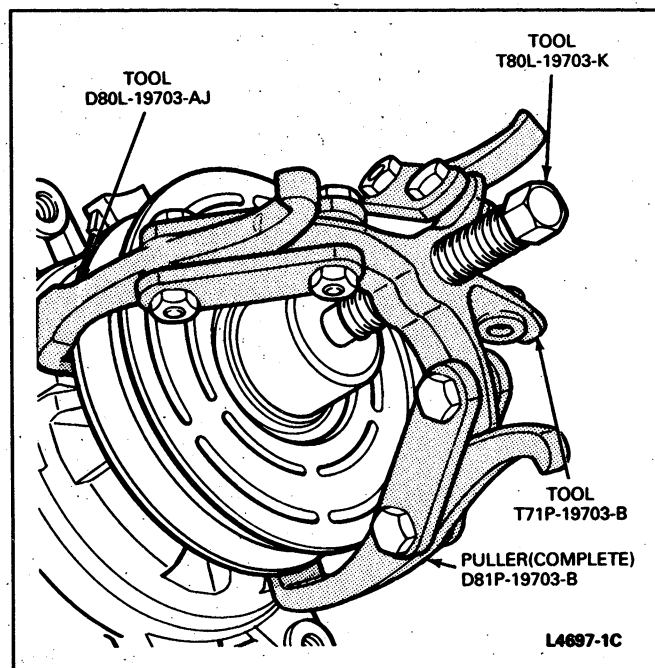


FIG. 7 Clutch Pulley—Removal

compressor shaft as necessary until the smallest air gap is within specification.

### Clutch Field Coil

#### Removal

1. Remove the clutch hub and pulley.
2. Remove the snap ring retaining the clutch field coil on the front of the compressor.
3. Pull the field coil from the front of the compressor.

#### Installation

1. Position the clutch field coil to the compressor engaging the locator pin on the compressor head with the hole in the clutch field coil.
2. Install the snap ring to retain the clutch field coil on the compressor with the bevel side of the snap ring out.

3. Install the pulley and hub on the compressor.

### Pulley Bearing

#### Removal

1. Remove the clutch hub and pulley from the compressor as outlined.
2. Remove the bearing retainer ring from the pulley hub (Fig. 6).
3. Position the largest opening of Clutch Pulley Support T81P-19623-J (Gold Colored) or equivalent over the hub of the pulley to support the pulley. Then, drive the bearing from the pulley with Pulley Replacer T80L-19703-J or equivalent as shown in Fig. 11.

#### Installation

1. Place the smallest opening of Clutch Pulley Support T81P-19623-J or equivalent over the dust shield on the clutch pulley friction face (Fig. 12). Then, place the clutch and tool on the bench with the clutch on top of the tool.
2. Position the new bearing to the clutch bearing bore and install the bearing in the bore until seated with Pulley Bearing Replacer T80L-19703-C or equivalent (Fig. 12).
3. Install the bearing retainer in the hub.
4. Install the pulley assembly and clutch hub.

## MAJOR SERVICE OPERATIONS

### Shaft Seal and/or Front Head Gasket and O-Ring

#### Removal

1. Remove the clutch assembly following the procedure for Clutch Field Coil Removal.
2. Invert the compressor and pour the refrigerant oil from the compressor into a container from the manifold openings.
3. Install Support and Clamp Tool T81P-19623-LH (with 4-1/2 inch long bolts), or equivalent on the compressor to retain the cylinder assembly and the rear head in position. Then, clamp the tool in a vise.

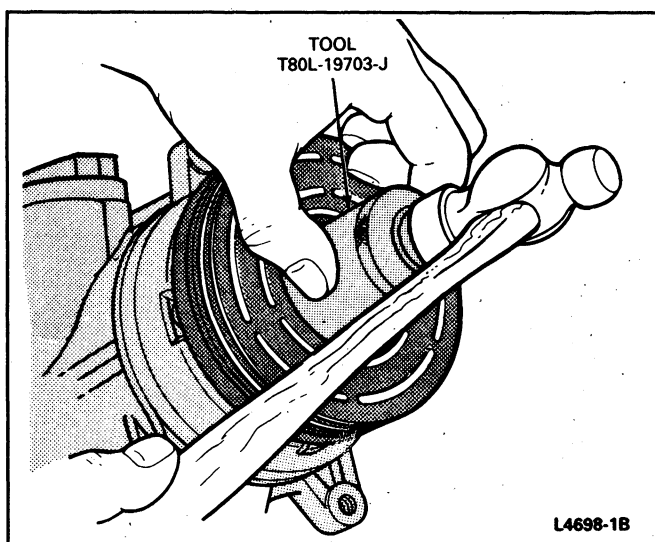


FIG. 8 Clutch Pulley—Installation

4. Remove the key from the compressor shaft with Shaft Key Remover T81P-19623-NH or equivalent (Fig. 13).
5. Remove the six through bolts from the compressor using a 6mm Allen wrench. Then, pull the front head from the compressor. The valve plate assembly, inlet reed, shaft seal and cylinder gasket normally will come off with the head assembly.

NOTE: Use extreme care not to damage any sealing surfaces.

6. Carefully lift the inlet reed valve from the head assembly.
7. Remove the front valve plate assembly and gasket from the front head.
8. Carefully remove the gasket from the valve plate assembly using care not to damage the surface of the valve and plate assembly.
9. Remove the dowel pin from the front head or compressor cylinder assembly.
10. Remove the shaft seal assembly and the felt wick and retainer from the head.
11. Place the head on a piece of clean corrugated cardboard and remove the seal seat assembly from the head with Shaft Seal Seat Remover T81P-19623-OH or equivalent (Fig. 14).
12. Clean the front head, valve plate assembly and a inlet reed with clean cleaning solvent. Dry the parts with compressed air.

#### Installation

1. Inspect the inlet reed, valve plate assembly and the front head for damage. Replace any damaged parts.
2. Install the dowel pin in the dowel pin hole of the cylinder assembly (Fig. 15).
3. Lubricate the inlet reed with a light coating of clean refrigerant oil. Then, position the inlet reed to the valve plate assembly aligning the dowel pin hole.
4. Assemble the valve plate assembly and inlet reed to the cylinder assembly aligning the dowel pin hole with the dowel pin.

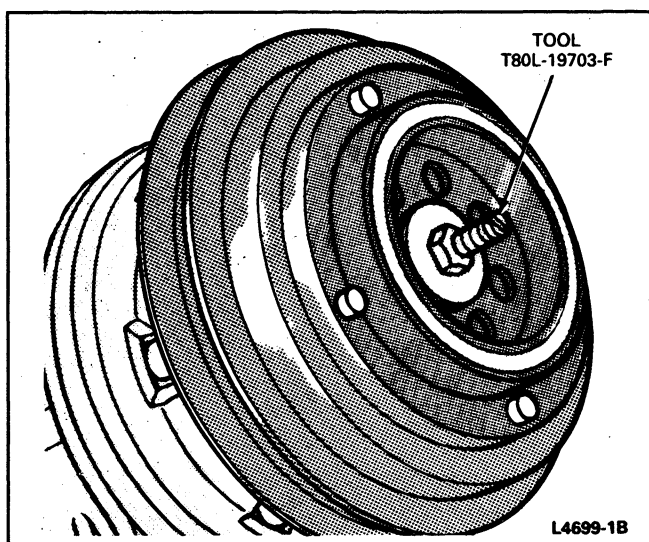


FIG. 9 Clutch Hub-Installation

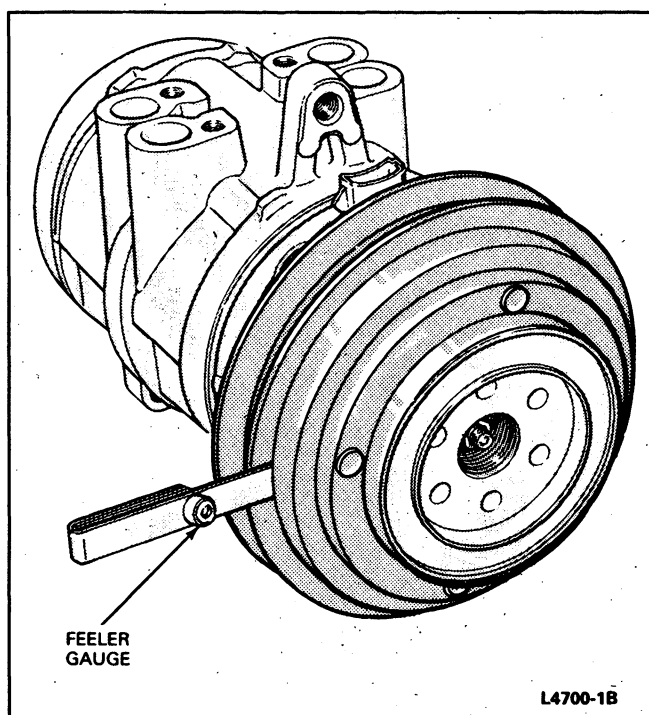


FIG. 10 Clutch Air Gap Check

5. Assemble a new cylinder gasket to the head side of the valve plate assembly aligning the dowel pin holes with the dowel pins (Fig. 15).
6. Lubricate the shaft seal seat with clean refrigerant oil and install the seat in the front head with the groove on the seat sealing surface up. Use Shaft Seal Seat Installer T81P-19623-C or equivalent, positioned in the groove of the seat to install the seat in the head (Fig. 16).

NOTE: Avoid handling the sealing surface of the seat. Use extreme care to keep the seal end and seal seat clean at all times.

**WARNING: IF THE SHAFT SEAL SEAT IS INSTALLED WITH THE GROOVE SIDE DOWN (TOWARD CLUTCH END OF COMPRESSOR), A LEAKING SHAFT SEAL WILL RESULT.**

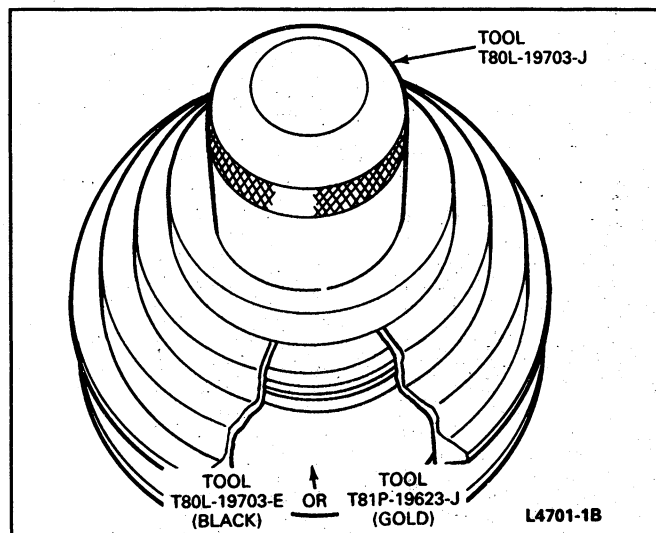


FIG. 11 Clutch Pulley Bearing—Removal

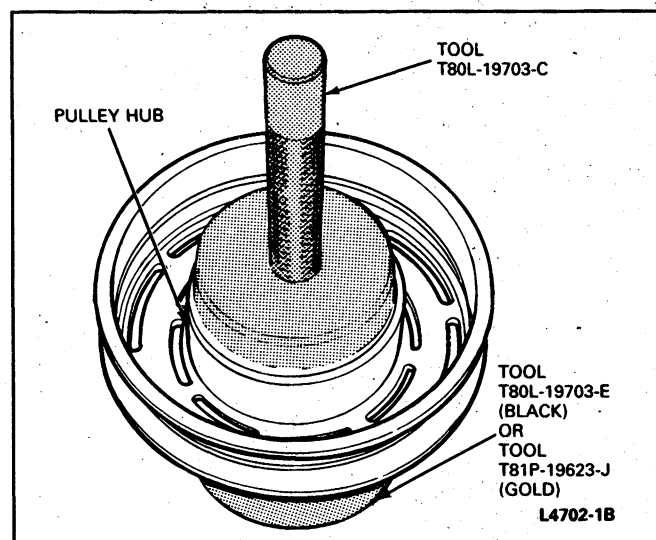


FIG. 12 Clutch Pulley Bearing—Installation

7. Lubricate the shaft seal with clean refrigerant oil and assemble the seal to the compressor with the sealing surface toward the end of the shaft. Engage the internal flats of the seal with the two flats notched into the shaft.

NOTE: Avoid handling the carbon sealing surface of the seal assembly to prevent damaging the surface.

8. Install a new lubricated O-ring in the O-ring groove of the front head (Fig. 15).
9. Position the front head to the cylinder assembly aligning the dowel pin hole in the head with the dowel pin. Install the six through bolts with brass washers and tighten to specification.
10. Remove the support end clamp tool and leak test the compressor as outlined.
11. Install the key in the slot of the compressor shaft and the felt and retainer in the drain hole of the head.
12. Install the clutch assembly on the compressor following the procedure for Clutch Field Coil Installation.

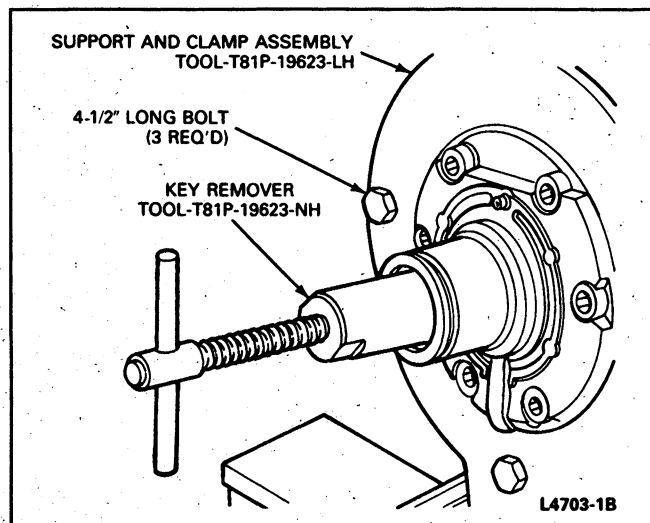


FIG. 13 Compressor Shaft Key—Removal

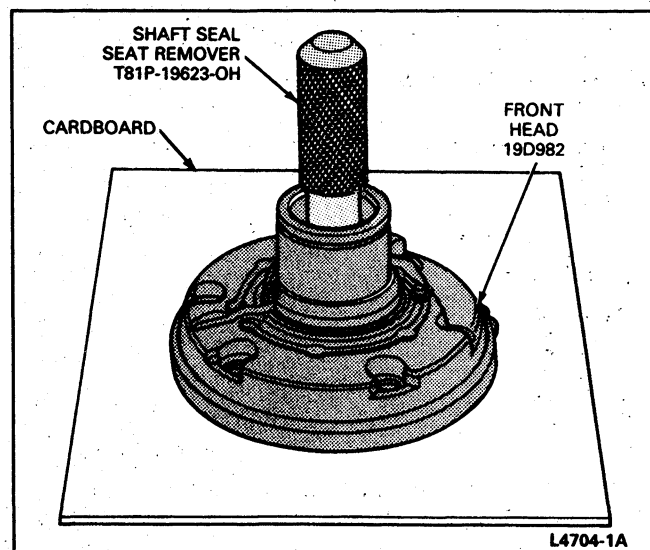


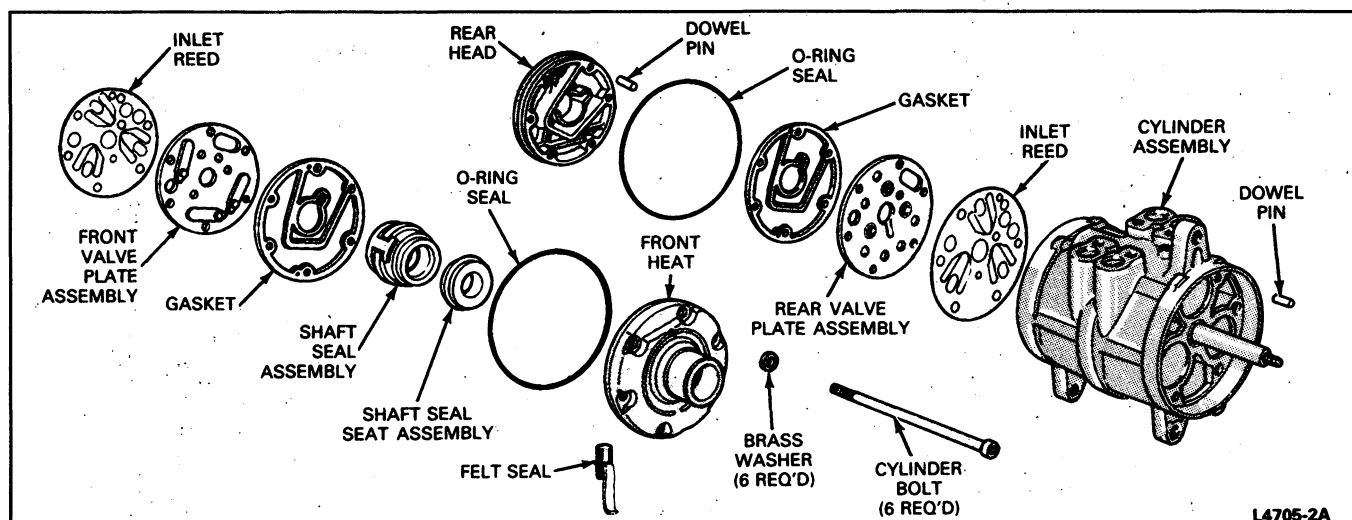
FIG. 14 Shaft Seal Seat Assembly—Removal—Typical

13. Install 180ml (6 fluid ounces) of clean refrigerant oil in the compressor.

## Head Gasket and O-Ring, Rear

### Removal

1. Remove the clutch assembly from the compressor following the procedure for Clutch Field Coil Removal.
2. Invert the compressor and pour the refrigerant oil into a container from the suction and discharge manifold opening.
3. Install Support and Clamp Tool T81P-19623-LH (with 4-1/2 inch long bolts) or equivalent on the front of the compressor to retain the cylinder assembly and the front head in position. Then, clamp the tool in a vise.
4. Hold the rear head and remove the six cylinder bolts from the cylinder assembly.
5. Separate the rear head assembly from the cylinder assembly and remove the O-ring from the head.
6. Remove the dowel pin.



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FIG. 15 Compressor Disassembled

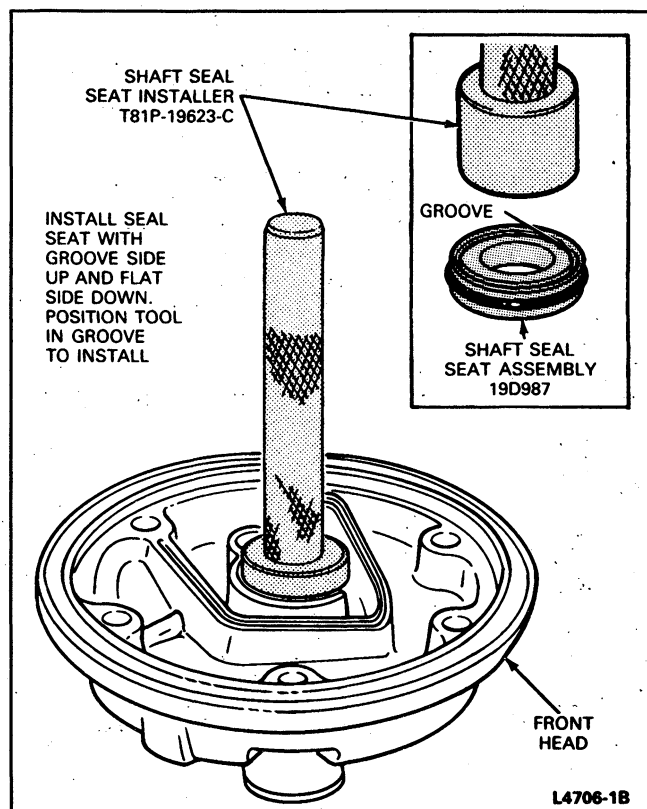
7. Remove the inlet reed from the rear head and valve plate assembly.
8. Remove the valve plate assembly from the rear head.
9. Carefully remove the cylinder gasket from the head and/or valve plate assembly.
10. Wash the rear head, valve plate assembly and inlet reed with clean cleaning solvent and dry with compressed air.
2. Invert the compressor and pour the refrigerant oil from the compressor into a container from both the suction and discharge manifold openings.
3. Install Support and Clamp Tool T81P-19623-LH or equivalent on the compressor to retain the front head and the cylinder assembly assembled together. Then, clamp the tool in a vise.
4. Remove the six through bolts from the compressor using a 6mm Allen wrench. Then, remove the rear head from the compressor. The valve plate assembly, inlet reed and the cylinder gasket will normally be removed with the rear head.

### Installation

1. Install the dowel pin in the dowel pin hole of the rear head.
2. Install the cylinder gasket on the head taking care to align the dowel pin hole with the dowel pin.
3. Install the valve plate assembly on the cylinder head aligning the dowel pin hole with the dowel pin (Fig. 15).
4. Lubricate the inlet reed with clean refrigerant oil. Then, install the inlet reed on the valve plate aligning the dowel pin hole with the dowel pin.
5. Install a new O-ring gasket lubricated with clean refrigerant oil into the O-ring groove of the rear head.
6. Position the rear head to the cylinder assembly and align the dowel pin with the dowel pin hole.
7. Hold the rear head in place and install the six through bolts with new brass washers and tighten to specification.
8. Remove compressor from the support and clamp tool.
9. Leak test the compressor as outlined.
10. Install the clutch assembly on the compressor following the procedure for Clutch Field Coil Installation.
11. Add 180ml (6 fluid ounces) of clean E73Z-19577-A or equivalent refrigerant oil to the compressor.

### Valve Plates and Inlet Reeds

1. Remove the clutch assembly from the compressor.



L4706-1B

FIG. 16 Shaft Seal Assembly-Installation

5. Remove the O-ring and inlet reed from the rear head.
  6. Remove the valve plate assembly from the rear head with Valve Plate Remover T81P-19623-PH or equivalent (Fig. 14). Use care not to lose the two dowel pins.
  7. Clean the rear head with clean cleaning solvent. Dry the head with compressed air.
  8. Install the dowel pin in the dowel pin hole of the cylinder assembly (Fig. 15).
  9. Position the inlet reed (lightly lubricated with refrigerant oil) to the valve plate assembly aligning the dowel pin holes.
  10. Position the valve plate assembly and inlet reed to the cylinder assembly aligning the dowel pin hole with the dowel pin.
  11. Install the cylinder gasket over the valve plate assembly aligning the dowel pin hole with the dowel pin.
  12. Install a new O-ring lubricated with clean refrigerant oil into the O-ring groove of the head assembly. Then, position the rear head to the cylinder assembly aligning the dowel pin hole in the head with the dowel pin.
  13. Press the rear into the recess of the cylinder assembly and install two through bolts into opposite holes to hold the rear head in place. Tighten the two bolts just snug.
  14. Remove and clamp the support Tool from the front half of the compressor and install the tool to clamp the rear head to the cylinder assembly.
  15. Remove the key from the compressor shaft with Shaft Key Remover T81P-19623-NH or equivalent (Fig. 13).
  16. Remove the two through bolts from the compressor.
  17. Pull the front head from the compressor assembly. The valve plate assembly, inlet reed and shaft seal assembly will usually come off with the front head (Fig. 15).
  18. Remove the O-ring and inlet reed from the front head.
  19. Remove valve plate assembly from the front head.
  20. Remove the dowel pin, the shaft seal and the cylinder gasket from the front head.
  21. Place the front head on a piece of clean corrugated cardboard and remove the seal seat assembly from the front head with Shaft Seal Seat Remover T81P-19623-OH or equivalent (Fig. 14).
  22. Remove the felt wick and retainer from the drain hole in the front head.
  23. Clean the front head with clean cleaning solvent and dry with compressed air.
  24. Install the dowel pin in the dowel pin hole of the cylinder assembly.
  25. Lubricate the inlet reed with a light coating of clean refrigerant oil. Then, position the inlet reed to the cylinder assembly aligning the dowel pin hole of the inlet reed with the dowel pin.
  26. Assemble the valve plate assembly to the cylinder assembly aligning the dowel pin hole with the dowel pin.
  27. Assemble the cylinder gasket to the valve plate assembly aligning the dowel pin hole with the dowel pin.
  28. Lubricate the new shaft seal seat with clean refrigerant oil and install the seat in the front head (groove side up) with Shaft Seal Seat Installer T81P-19623-C or equivalent (Fig. 16). Be sure the tool is positioned in the groove of the seat assembly and that the shaft seal seat is positioned against the recess in the front head.
- CAUTION: Avoid handling the sealing surface of the seat. Use extreme care to keep the seal and seal seat clean at all times.**
29. Lubricate the shaft seal with clean refrigerant oil and assemble the seal on the compressor shaft with the sealing surface toward the end of the shaft. Engage the internal flats of the seal with the two flats notched into the shaft.
- NOTE:** Avoid handling the carbon sealing surface of the seal assembly to prevent damaging the surface.
30. Install a new lubricated O-ring in the O-ring groove of the front head.
  31. Position the front head to the cylinder assembly aligning the dowel pin hole in the head with the dowel pin. Install the six through bolts using new brass flat washers (Fig. 15). Tighten the through bolts to specification.
  32. Install a new felt wick and retainer in the front head drain hole.
  33. Install the key in the slot of the compressor shaft with the rounded end toward the compressor body.
  34. Remove the support and clamp tool and leak test the compressor as outlined in this Section.
  35. Install the clutch assembly on the compressor.
  36. Add 180ml (6 fluid ounces) of clean E737-19577-A or equivalent refrigerant oil to the compressor.

### Head Replacement

If it is necessary to replace the front or rear head follow the service procedure for head gasket replacement.

## SPECIFICATIONS

## COMPRESSOR

<b>TYPE — Swash Rate —</b> Three double acting pistons — Axial Type			
<b>DISPLACEMENT</b>		171 C.C.	
<b>ROTATION</b>		Clockwise	
<b>ROTATIONAL TORQUE</b> (Maximum-Manifold Removed)		10 N·m (7 lb-ft)	
<b>REFRIGERANT OIL</b> Type (Spec.)		ESH-M2C31-A2	
Capacity (New)		10 Fluid Ounces	
Part Number		E73Z-19577-A Motorcraft YN-9	
<b>DRIVE BELT TENSION — LBS.</b>			
<b>Belt Type</b>	<b>New</b>	<b>Used Minimum</b>	<b>Used Reset Limits</b>
6KV Ribbed	667-845 (150-190)	400 (90)	622-711 (140-160)
3/8 Inch V	533-711 (120-160)	311 (70)	489-578 (110-130)
<b>MAGNETIC CLUTCH</b> Air Gap Between Pulley and Hub Current Draw Run-Out (Maximum)			
		0.021-0.036 inch 4.67 Amps @ 12.8 volts 0.02 inch — Radial or Axial	
<b>TORQUE LIMITS</b> Hose Manifold to Compressor Clutch Hub Nut Compressor Cylinder Bolts			
		18-23 N·m (13-17 lb-ft) 13-20 N·m (10-14 lb-ft) 24.5-26.5 N·m (18-19 lb-ft)	

CL4707-1E

## ROTUNDA EQUIPMENT

Model	Description
055-00015	Electronic Leak Detector

CL5733-1A

Rotunda Tool Number	Motorcraft Tool No.	Robinair Tool No.	Draf Tool No.	Description
T81P-19623-LH	YT-1067	18015	1067	Support and Clamp Assembly
T81P-19623-MH	YT-499	10546	499	Spanner Wrench
T81P-19623-NH	YT-1062	18005	1062	Shaft Key Remover
T81P-19623-OH	YT-1060	40495	—	Shaft Seal Seat Remover
T81P-19623-PH	—	—	—	Valve Plate Remover
T81P-19623-B	YT-1069	41120	1069	Valve Plate Remover
T81P-19623-C	YT-1061	40945	1061	Shaft Seal Seat Installer
T81P-19623-J	YT-1065	18001	1065	Clutch Pulley Support (Nippondenso Clutch)
D80L-19703-AJ	YT-1058	40679	1058	Pulley Puller Jaws
D81P-19703-B	—	10501	—	Complete Pulley Puller
T71P-19703-B	YT-457	40710	457	Pulley Puller Hub
T80L-19703-B	YT-1011	10884	1011	Hub Remover
T80L-19703-C	YT-1059	40930	1059	Pulley Bearing Replacer
T80L-19703-F	YT-1052	18020	1052	Hub Installer
T80L-19703-G	YT-1012	41358	1012	Compressor Shaft Protector
T80L-19703-J	YT-1059	40938	1059	Pulley Replacer
T80L-19703-K	YT-451	40568	451	Pulley Puller Center Bolt
T81P-19623-F	YT-1066	40941/40942	1066	Pressure Test Fittings
D85L-19703-A	—	40947	—	Pressure Test Adapter — 2 Req'd.
T81P-19623-G1	—	41098	—	3/8 Inch Spring Lock Coupling Disconnect Tool
T81P-19623-G2	—	41099	—	1/2 Inch Spring Lock Coupling Disconnect Tool
T83P-19623-C	—	41100	—	5/8 Inch Spring Lock Coupling Disconnect Tool
T85L-19623-A	—	41101	—	3/4 Inch Spring Lock Coupling Disconnect Tool

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# SECTION 36-61 F-150 Through F-350 and Bronco Manual A/C-Heater System

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Cables .....	36-61-17	Floor/Defrost Door Motor .....	36-61-25
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<b>DIAGNOSIS AND TESTING</b> .....	36-61-17	Heater Hoses .....	36-61-35
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## VEHICLE APPLICATION

F-150 Through F-350, F-Super Duty and Bronco.

## DESCRIPTION

Most of the major components of the manual A/C-Heater system used in the F-150 through F-350 and Bronco vehicles are identified in Fig. 1.

Refer to Fig. 1 for part names and locations. Details regarding the physical and functional characteristics of the components will follow.

As preliminary information, the system is equipped with:

- A plate-fin evaporator core and attached suction accumulator/drier
- A fixed orifice tube for control of refrigerant flow
- A clutch cycling pressure switch

Two Schrader-type service access gauge port valves are used in the manual A/C-Heater system. The high pressure valve is located near the condenser in the discharge line and has a quick disconnect-type valve body. This requires a special high pressure service access valve adapter to connect a manifold gauge set or a charging station to the valve. The other service access gauge port valve is located on the inlet of the suction accumulator and is used to measure evaporator pressure.

The evaporator case assembly is attached to the engine side of the dash panel. It contains the:

- Evaporator core
- Accumulator/drier
- Blower motor and wheel
- Blower resistor
- Outside air/recirc door and its vacuum motor
- Vacuum reservoir
- Vacuum/wiring harness assemblies

The suction accumulator/drier is clamped to the evaporator case with its inlet tube connected to the evaporator outlet tube. The A/C clutch cycling pressure switch is installed in a fitting on the side of the accumulator/drier. The inlet tube to the evaporator core houses the fixed orifice tube.

The plenum is located in the passenger compartment. It contains the:

- Heat/defrost door
- Temperature blend door
- Vent/heat door
- Cam/crank which operate the temperature door
- Heater core
- Vacuum motor assemblies which operate the floor/defrost and panel/defrost doors.

The defroster nozzle has five outlets and connects between the plenum and the defrost outlet on the instrument panel. The control is a two-cable mechanical type (function and temperature). A separate vacuum

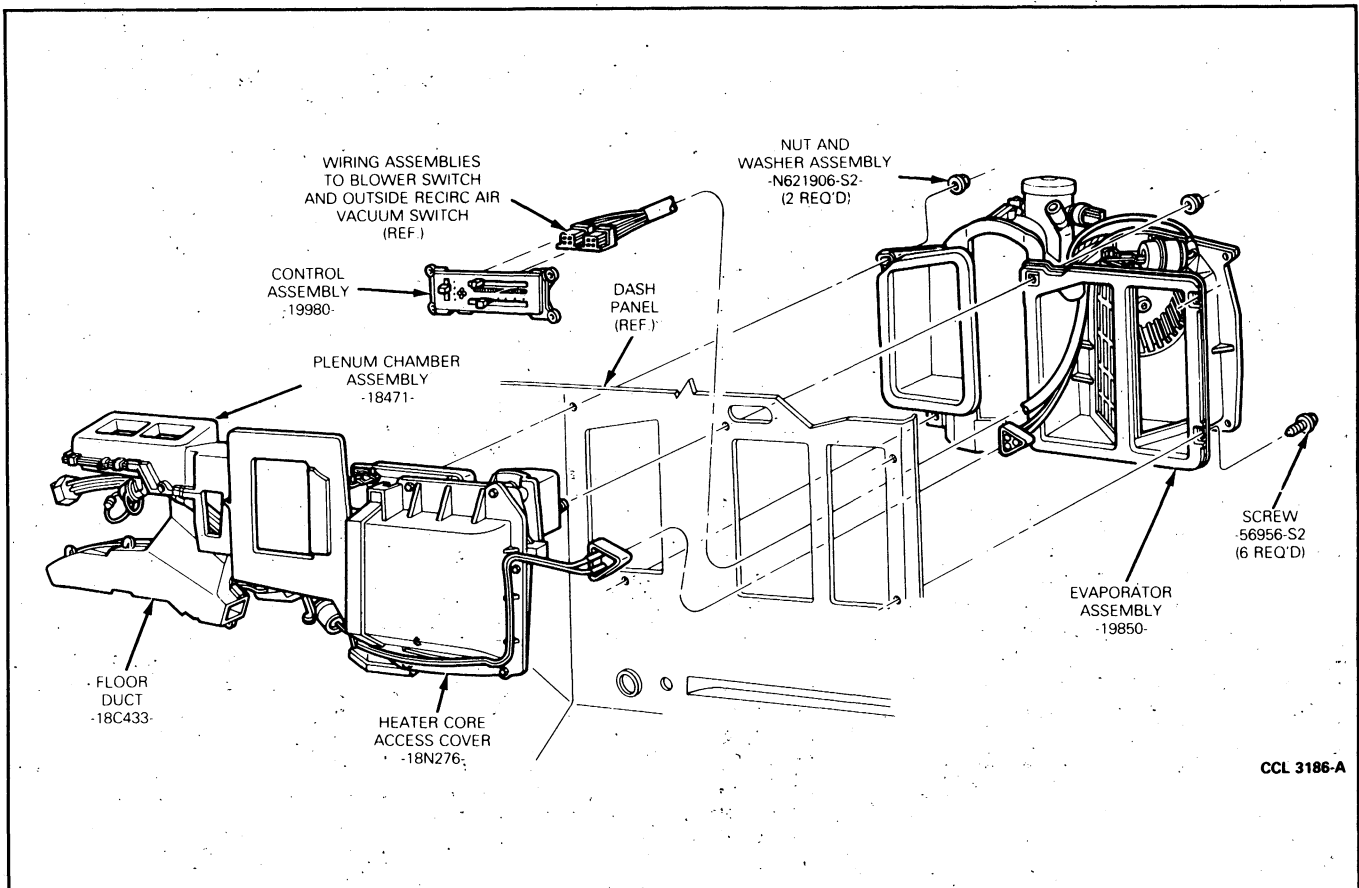


FIG. 1. Manual A/C-Heater System (F-150—F-350 F-Super Duty, Bronco)

switch is provided to actuate the outside air shutoff door.

The control assembly contains four levers, one of which functions as a blower switch. The control also contains an A/C ON-OFF pushbutton switch to control A/C operation. The A/C ON-OFF pushbutton switch is part of the blower switch and will not close for A/C operation unless the blower switch is on.

The defroster nozzle has five outlets. It is installed between the plenum and the defroster outlet in the instrument panel.

The control assembly is installed in an opening in the instrument panel. The control assembly contains three levers. One lever operates the four-position blower switch and one selects the function under which the system will perform (MAX A/C, NORM A/C, VENT, FLOOR, FLOOR/DEFROST or DEFROST) by controlling vacuum motor operation. The third lever regulates temperature by means of a cable which controls the position of the temperature blend air door.

## OPERATION

### Airflow

During operation, outside air is drawn into the system by a blower motor and wheel from the cowl air intake when the function lever is in NORM A/C, VENT, FLOOR, FLOOR/DEFROST, or DEFROST position. When the air door lever is in the MAX-A/C position, airflow is drawn from inside the vehicle through the recirculating air door opening. The air is then forced by the blower through the evaporator core and, depending

upon the setting of the temperature lever, is forced by the blower through and/or around the heater core into the plenum. Air is then directed to the floor and/or defrost nozzles or the instrument panel registers, depending upon the position of the function selector lever.

Figs. 2 and 3 illustrate airflow through the system when control levers are moved from position-to-position.

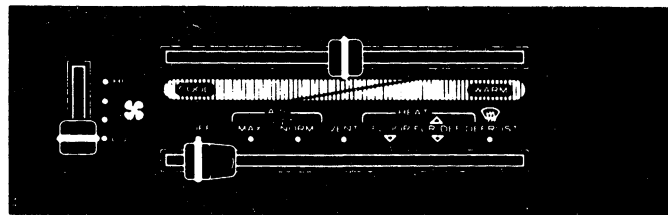
Airflow volume through the system is controlled by a lever-operated, five-position blower switch. The blower switch, used with a resistor assembly, provides four blower speeds to control airflow through the system. The blower can be shut off by moving the lever to the OFF position.

### Refrigerant Flow

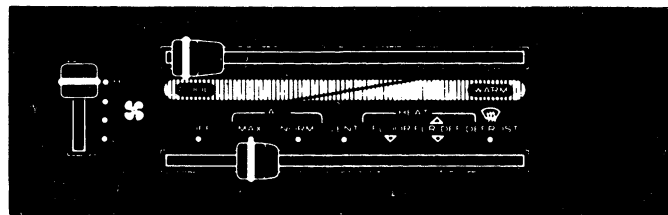
Fig. 4 shows a basic refrigerant circuit representing refrigerant changes as it passes through a cycle from compressor output to compressor input.

The illustration identifies four states in which refrigerant will exist in a closed circuit: (1) High pressure vapor, (2) High pressure liquid, (3) Low pressure liquid, and (4) Low pressure vapor. Beginning with compressor output, refrigerant moves as a high pressure vapor to the condenser. As it passes through the condenser, the vapor condenses into a liquid.

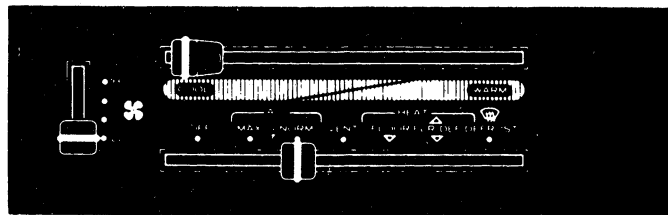
In the course of this condensation process, the refrigerant gives up heat. This heat exchange does not alter the temperature of the refrigerant. Thus, the refrigerant continues its flow through the circuit as a high temperature, high pressure liquid.



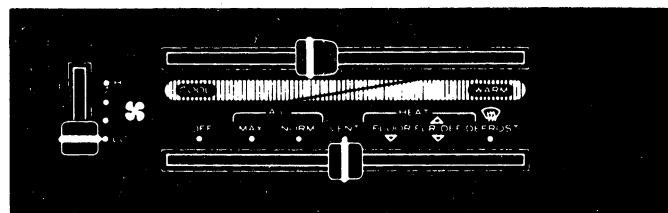
OFF POSITION



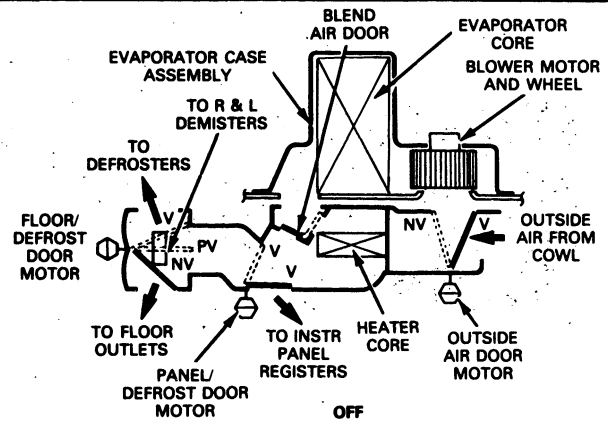
MAX A/C POSITION



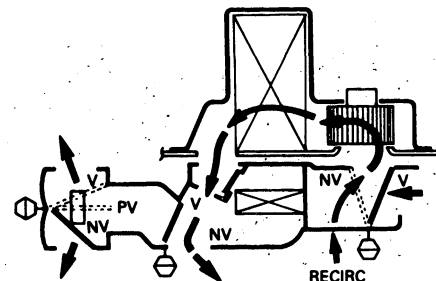
NORM A/C POSITION



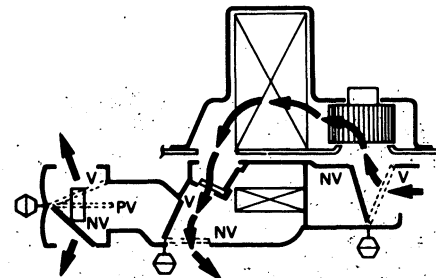
VENT POSITION



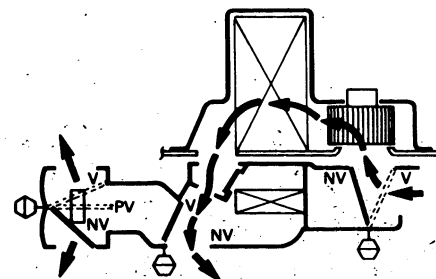
OFF



MAX A/C



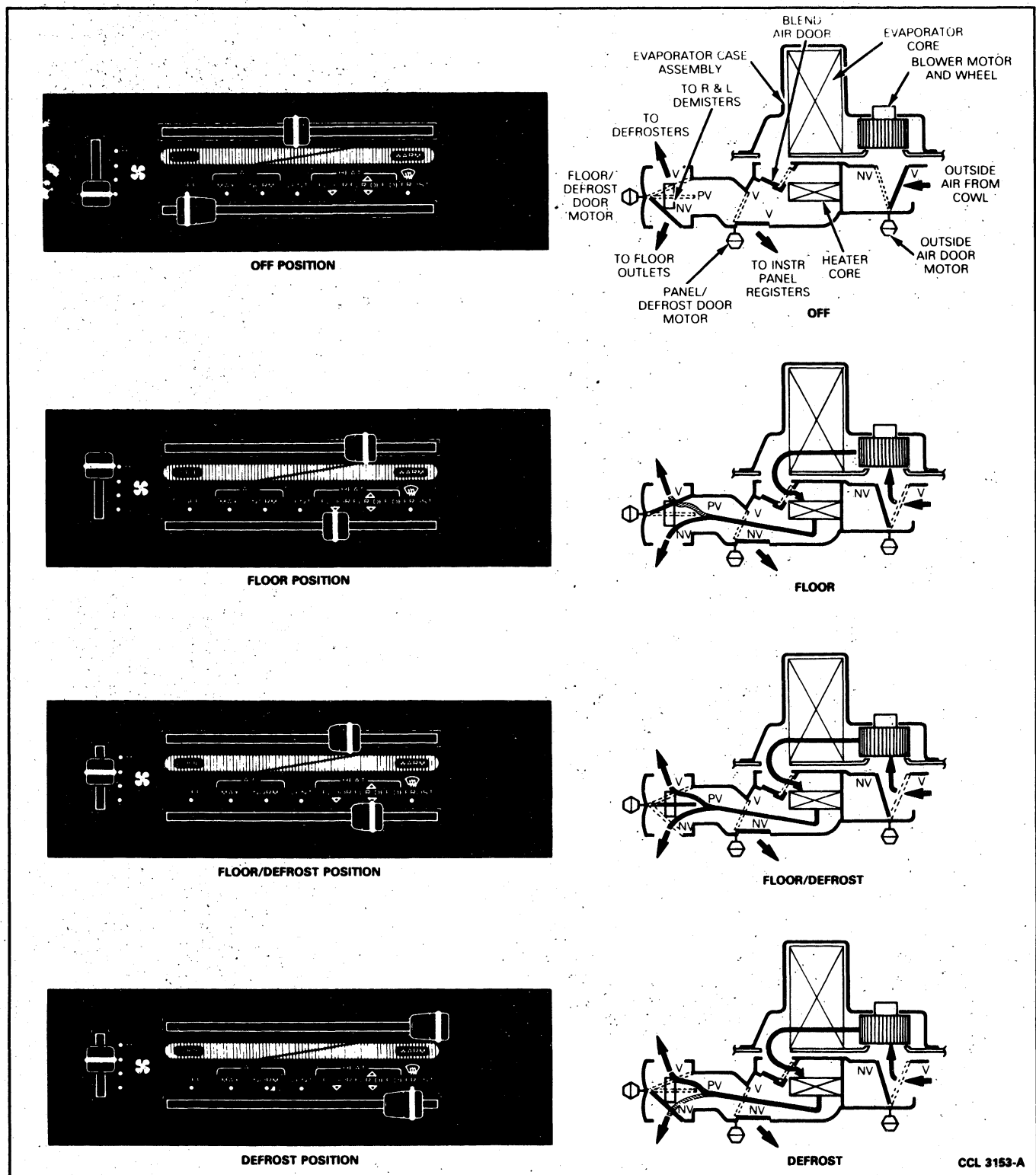
NORM A/C



VENT

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FIG. 2 Manual A/C-Heater Airflow Schematic (A/C, Panel Heat, Floor Heat)



**FIG. 3 Manual A/C-Heater Airflow Schematic (Mix, Defrost)**

The restriction called out in the illustration in F-150—F-350, F-Super Duty, and Bronco applications is a fixed orifice tube which contains a 1.575mm (0.062 inch) orifice. When the refrigerant passes through this tube, it changes from a high to low pressure liquid, with a corresponding drop in temperature.

The refrigerant, upon leaving the orifice tube, is drawn through the circuit by compressor suction. Thus,

it enters the evaporator as a low pressure/low temperature liquid.

The cooling of the evaporator core creates a temperature differential between the core and the ambient air in the evaporator case. As a result of this difference, heat is absorbed from the air. Simultaneously, humidity is extracted from the air and drained onto the surface under the vehicle. Again, the

absorption of BTUs does not affect refrigerant temperature.

Refrigerant flow, after leaving the evaporator, continues through the suction accumulator/drier where water is absorbed into a desiccant bag and the more heavily oil-laden refrigerant is further vaporized as it is dispelled into the inlet line to the compressor.

The cooled, dehumidified air in the evaporator case is pushed by the blower through the case and out through ducting to the registers in the instrument panel.

Extending this basic coverage of a refrigerant circuit, the following traces refrigerant flow through actual circuit components.

When the A/C system is not on, refrigerant system pressures are equalized on both the high and low sides of the refrigerant system. In both cases, the refrigerant is in a vapor state.

When the function control lever is set on A/C (MAX or NORM), FLOOR/DEFROST or DEFROST, the A/C compressor magnetic clutch field coil is energized and the clutch plate is pulled into contact with the clutch pulley. The clutch plate and hub assembly then rotates the compressor shaft.

When the compressor shaft is rotated, the double ended pistons move backward and forward in their respective cylinder bores. As each piston is moved backward in its cylinder bore, the pressure in the cylinder suddenly reduces to a pressure (or vacuum) considerably lower than the refrigerant vapor pressure on the suction side of the refrigerant system. The higher refrigerant system vapor pressure overcomes the suction reed valve spring pressure, forcing itself through the reed valve and into the lower pressure (or vacuum) area inside the compressor cylinder. The spring pressure on the reed valve closes the valve when the refrigerant system suction vapor pressure and the compressor cylinder vapor pressure are equalized.

As each piston is forced into its respective cylinder bore, the refrigerant vapors from the suction side of the refrigerant system are compressed into a decreasingly smaller area, thus increasing the refrigerant vapor pressure and also raising the refrigerant vapor temperature. The higher refrigerant vapor pressure now assists in sealing the suction reed valve closed and also opens the discharge (high pressure) reed valve as the cylinder pressure exceeds the higher pressure side of the refrigerant system. When the compressed higher pressure and temperature refrigerant vapor is discharged into the high pressure side of the refrigerant system, the discharge reed valve spring pressure and the high side refrigerant pressure closes and seals the reed valve, thus preventing the discharge pressure from re-entering the compressor cylinder. The compressor's refrigerant vapor compression cycle begins again as the pistons are again pulled from their respective compressor cylinder bores by the rotating compressor shaft.

The high pressure and high temperature compressor discharge refrigerant vapor is released into the top of the condenser assembly, via the compressor's discharge hose. The condenser, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant vapor by ambient air passing over the condenser fins and tubing.

Refer to Fig. 4.

Liquid refrigerant from the condenser outlet enters the high pressure liquid line and then the inlet side of the fixed orifice tube located in the evaporator inlet tube. The inlet filter screen of the fixed orifice tube assembly removes coarse contaminant particulates, which may be present in the liquid refrigerant, before the liquid refrigerant enters the calibrated opening of the fixed orifice tube. The outlet end of the orifice tube assembly has a fine mesh filter with four open side slots in the body of the tube assembly, upstream from the filter. This filter removes fine contaminants and allows some of the refrigerant to exit through the non-filtered side slots. The side slots and filter act as a refrigerant flow noise suppressor.

Evaporator pressure is reduced as a result of A/C compressor suction. As the evaporator pressure is lowered and the liquid line pressure increases, the liquid refrigerant passes through the fixed orifice tube and enters the evaporator at a low pressure and as a cold liquid. As airflow passes over the plate-fin sections of the evaporator core, the refrigerant inside absorbs the heat and changes into a vapor.

Compressor suction draws the vaporized refrigerant and oil mixture into the suction accumulator/drier where the heavier, oil-laden vapors fall to the bottom and the lighter vapors and oil mixture continue their path to the compressor via the top of the vapor return tube. A desiccant bag, located inside the suction accumulator/drier, absorbs and retains moisture which may be circulating in the refrigerant system. The heavier, oil-laden refrigerant also returns to the compressor through a small liquid bleed hole near the bottom of the vapor return tube. The liquid bleed hole provides a controlled second opportunity for the accumulated refrigerant and oil mixture to revaporize as it passes through the opening to re-enter into the main vapor flow path to the suction side of the compressor.

### Summary

Refer to Figs. 2 and 3 for the control assembly and lever positions.

**Airflow**—Air can be distributed through the instrument panel registers, the floor outlets, and the defroster outlets depending upon the position of the function selector lever. Airflow to the side window demisters occurs in all control assembly lever settings except PANEL.

Fig. 5 is a diagram of the vacuum system and how it controls the PANEL/DEFROST, FLOOR and FLOOR/DEFROST doors.

**Function Control**—When the function selector lever is in the A/C (MAX and NORM) and VENT positions, air flows out of the panel registers. Moving the function lever to the FLOOR position directs airflow to the floor outlets with a slight bleed to the defroster outlets. The FLOOR/DEFROST position splits the air between the floor outlets and the defroster outlets, and DEFROST position directs airflow to the defroster outlets with a slight bleed to the floor outlets (Fig. 6).

The function lever actuates a vacuum switch which controls the movement of the door. A selector vacuum harness running between the switch and the vacuum motor transmits the power needed to position the door.

In the NORM A/C, VENT, FLOOR, FLOOR/DEFROST and DEFROST positions, outside air is drawn into the system by the blower. In the OFF/MAX

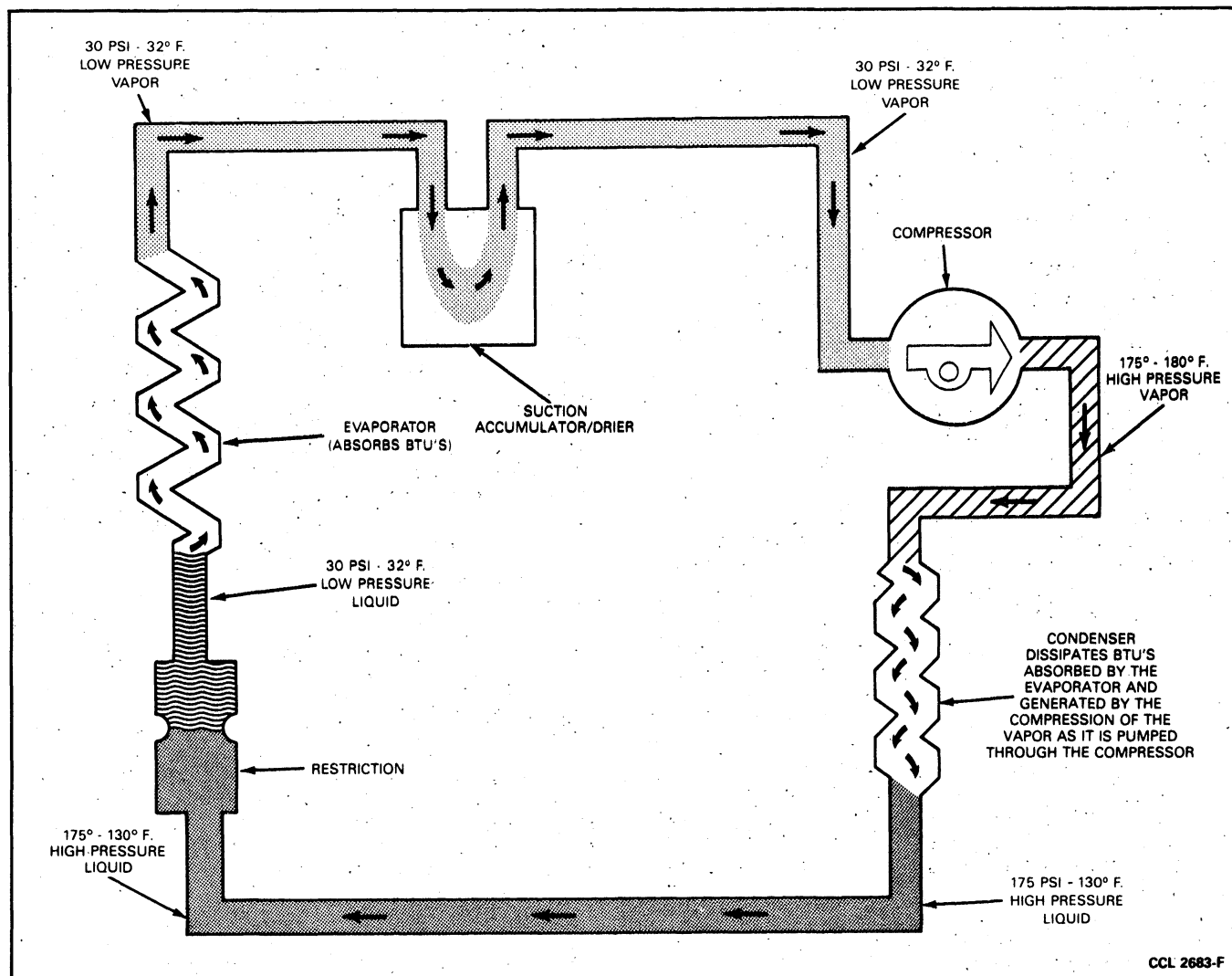


FIG. 4 Refrigerant Cycle

A/C position, the recirc door is positioned so that outside air cannot pass into the evaporator case.

**Temperature Control**—Temperature is controlled by a cable-operated air blend door in the plenum assembly. When the temperature control lever is in the COOL (extreme LH) position, all air is directed around the heater core.

When the temperature control lever is moved to the WARM (extreme RH) position, all air is directed through the heater core. When the temperature control lever is between COOL and WARM (between extreme LH and extreme RH), air is directed through and around the heater core in proportion to the position of the temperature control lever between the extremes of its travel.

**Blower Control**—Blower speeds are controlled by a four-position blower switch and a resistor assembly located in the evaporator case upstream from the evaporator core (Fig. 7).

The switch is used to select low, two intermediate, or high blower speed settings. The blower is turned off by the blower speed selector lever when it is in the OFF position.

**A/C System Control**—The A/C system is turned on and off by the function selector lever. When the lever is

set in A/C (MAX and NORM), FLOOR/DEFROST, DEFROST positions, electrical current flows through the pressure switch to the compressor clutch coil; the clutch engages and the A/C system is on. When the lever is set in OFF, VENT or FLOOR positions, current is stopped to the compressor clutch coil and the A/C system is off.

## System Components

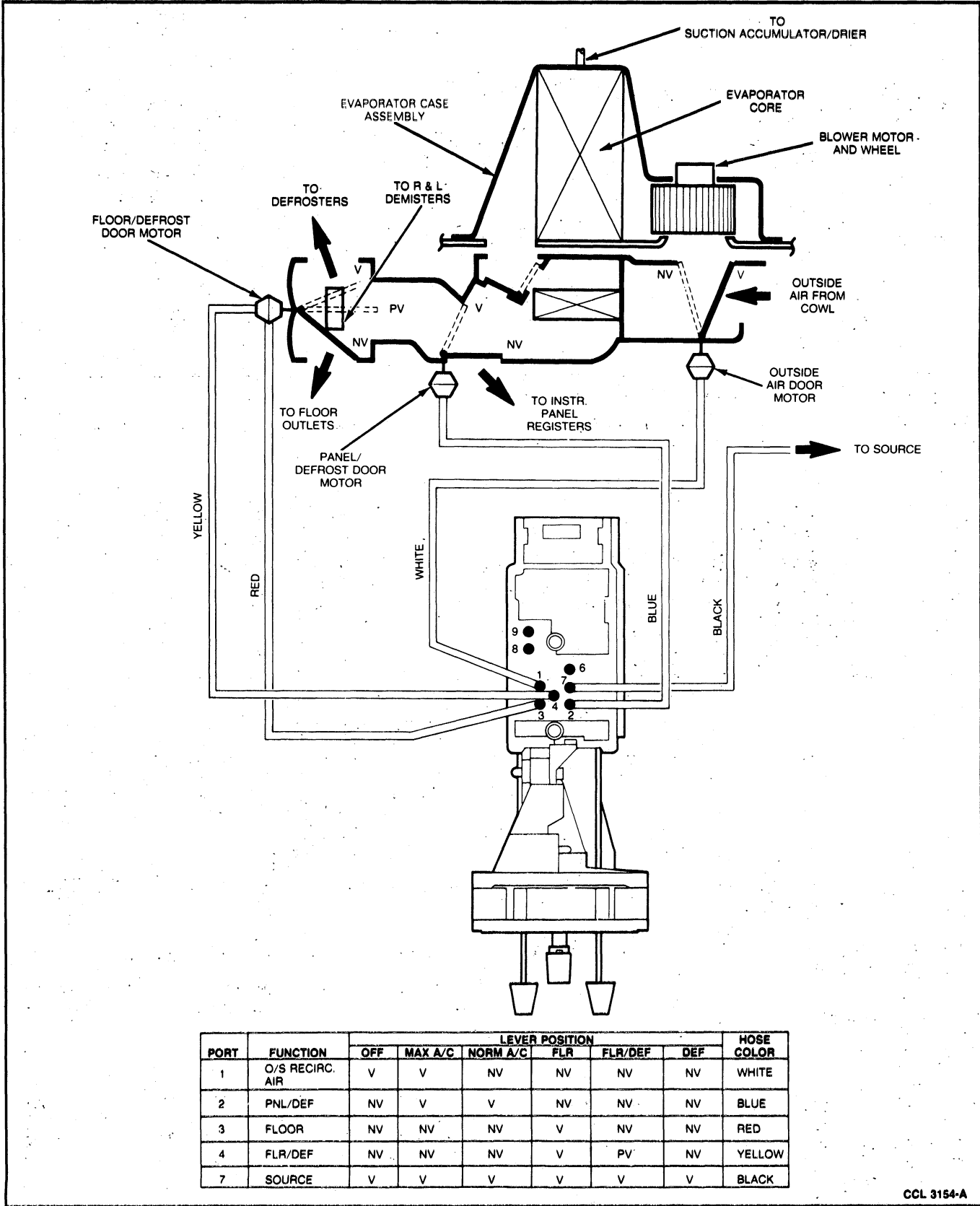
### Evaporator Case Assembly

The evaporator case assembly is attached to the engine side of the dash panel (Fig. 8).

The case is a two-piece molded construction, one piece of which forms a cover over the evaporator core. An integral vacuum reservoir is part of the cover housing. This reservoir and the vacuum motor, which operates the outside/recirc air door, are linked through a check valve to a hose that supplies engine vacuum.

The blower housing is an integral part of the evaporator case. It houses the blower motor and wheel assembly which attaches to the case through a mounting flange on the blower motor.

The blower motor resistor assembly is attached to the case with its thermal elements extending into the air stream inside the evaporator case. The suction



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FIG. 5 Vacuum Diagram

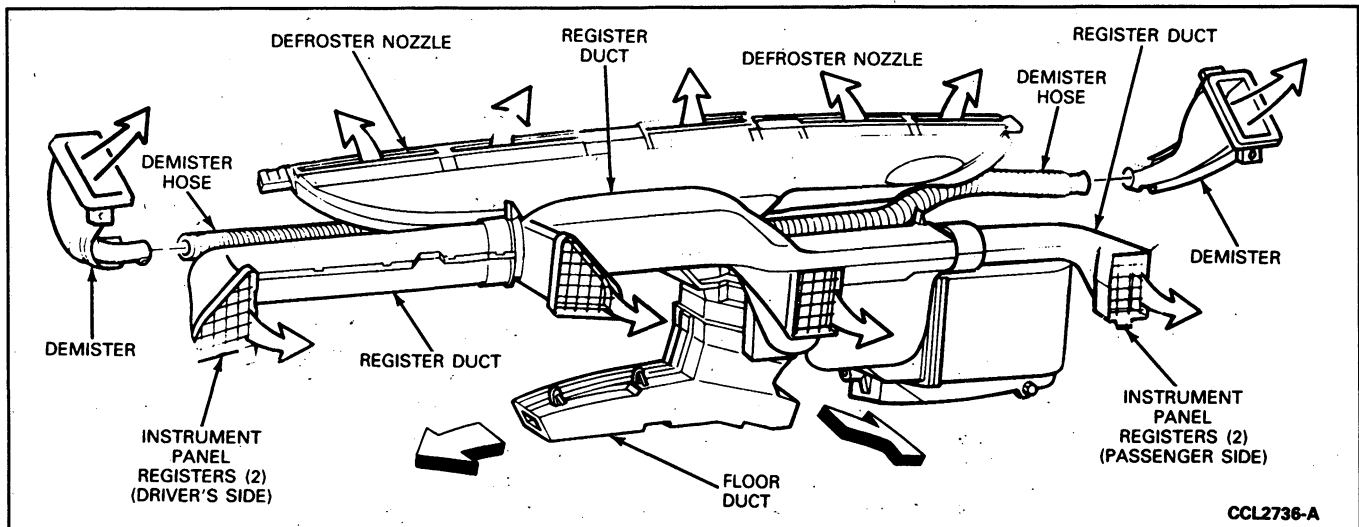


FIG. 6 Airflow Into Passenger Compartment

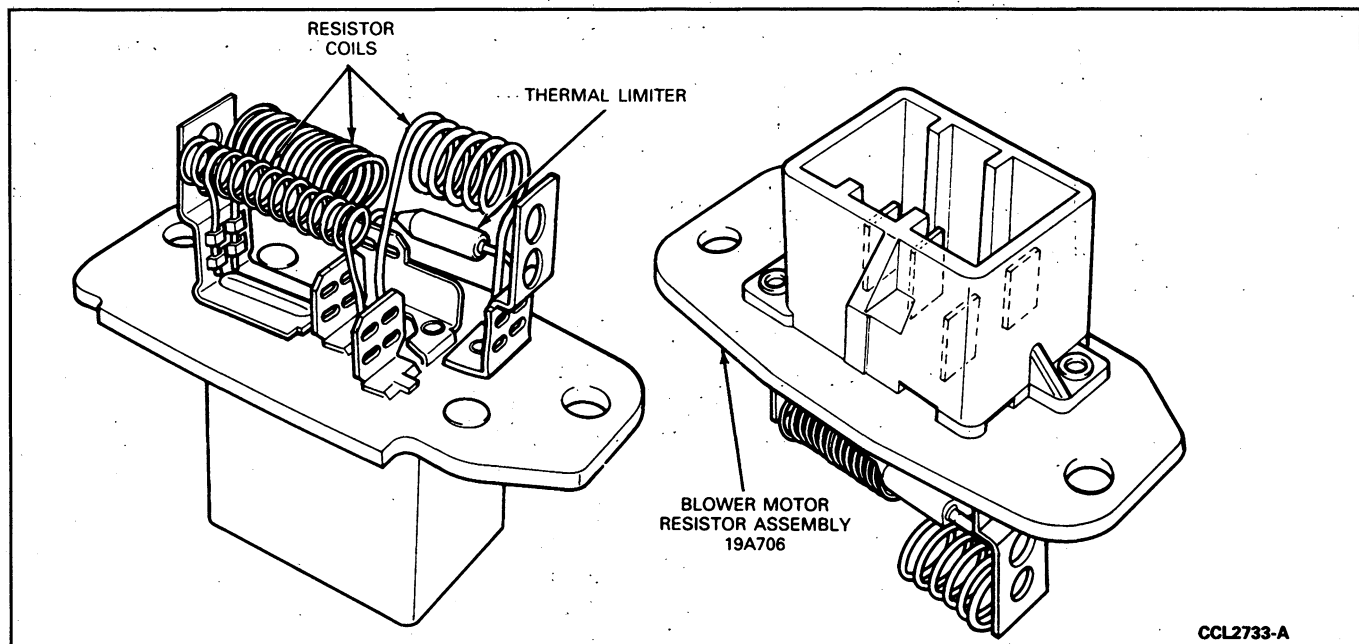


FIG. 7 Blower Motor Resistor

accumulator/drier is attached to the evaporator core by a support bracket.

### Plenum Assembly

Refer to Fig. 9.

The plenum assembly is mounted to the dash panel in the passenger compartment. It contains the heater core, temperature blend door, panel door and the floor/defrost door. The temperature blend door is cable-controlled through a cam located on top of the plenum (Fig. 26). The panel and floor/defrost doors are both controlled by vacuum motors, located on the bottom of the plenum.

The heater core is located in the plenum behind the heater core cover. The cover allows the core to be removed without removing the plenum.

### Evaporator Case and Plenum Assemblies

Fig. 10 illustrates how the evaporator case and plenum assemblies attach on each side of the dash panel.

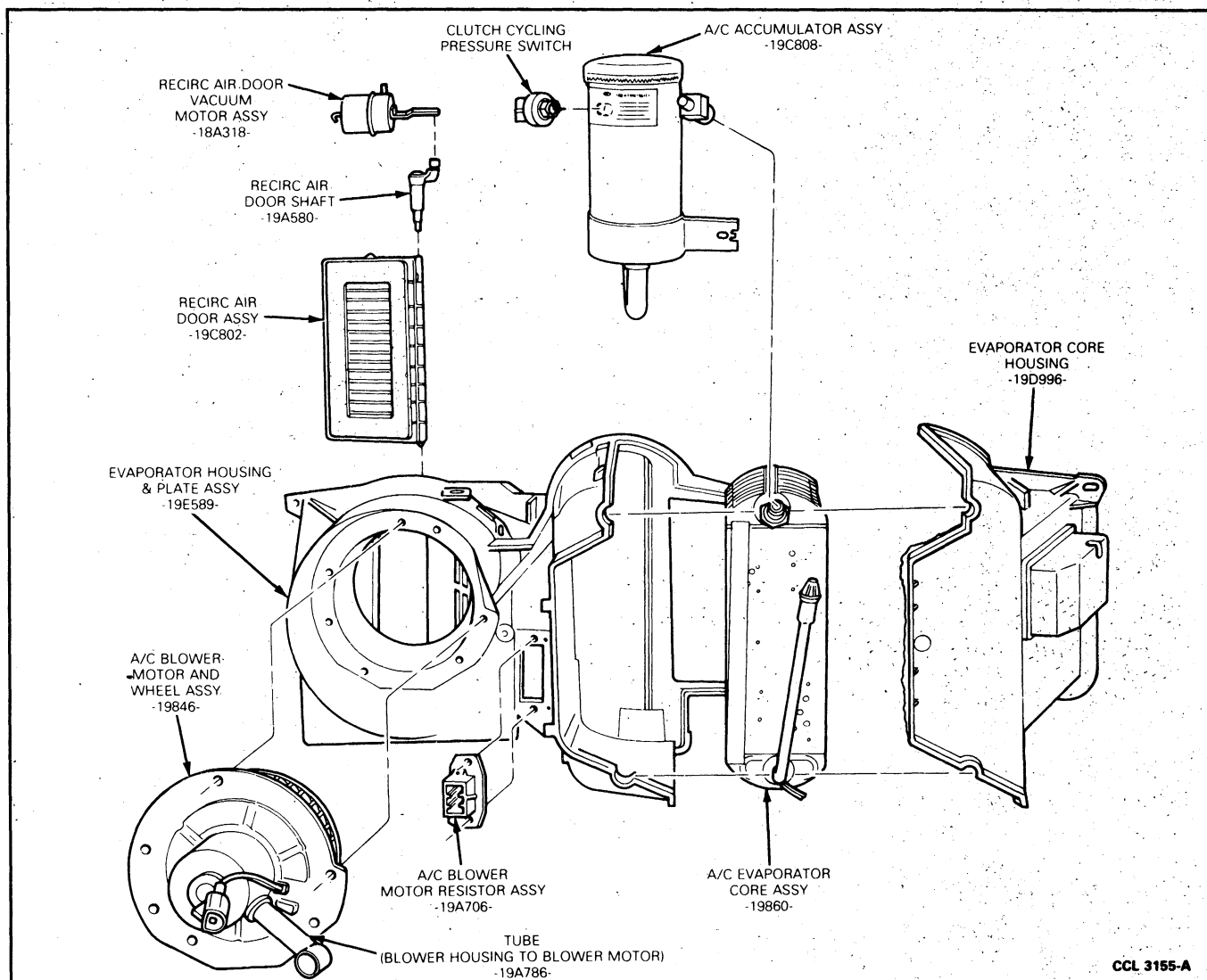
### Defroster Nozzle

The defroster nozzle attaches to the instrument panel with four screws and one screw to the center air duct. It directs air onto the windshield through five slotted openings in the upper, forward portion of the panel (Fig. 11).

### Demister Nozzles and Hoses

Fig. 12 illustrates the parts which make up the side window demister system. A separate nozzle attaches to a register which is molded into each end of the instrument panel. A separate hose leads from each nozzle to a connector attached to the center air duct.





CCL 3155-A

FIG. 8 Evaporator Case, Assembly—Disassembled View

### Register Ducts

The register ducts are three one-piece molded parts which attach to the underside of the instrument panel (Fig. 13).

The ducts feed four registers in the instrument panel. A triangular-shaped register is located on each side of the instrument cluster (Fig. 14) and one of two rectangular registers is located at the immediate right of the heater-A/C control assembly. The other rectangular register is located near the RH edge of the instrument panel.

### Outside Air/Recirculation Air Door

The outside air/recirculation air door is located in the evaporator case assembly (Fig. 15). It is operated by a vacuum motor in response to movement of the function air control lever.

When the lever is in the NORM, A/C, VENT, FLOOR, FLOOR/DEFROST, DEFROST positions, the door is open to admit outside air; when the lever is in the OFF/MAX A/C position, the door is moved by vacuum to shut off outside air and open the passageway so that inside air can be recirculated through the system.

### Control Assembly

The control assembly is installed in the center of the instrument panel (Fig. 16).

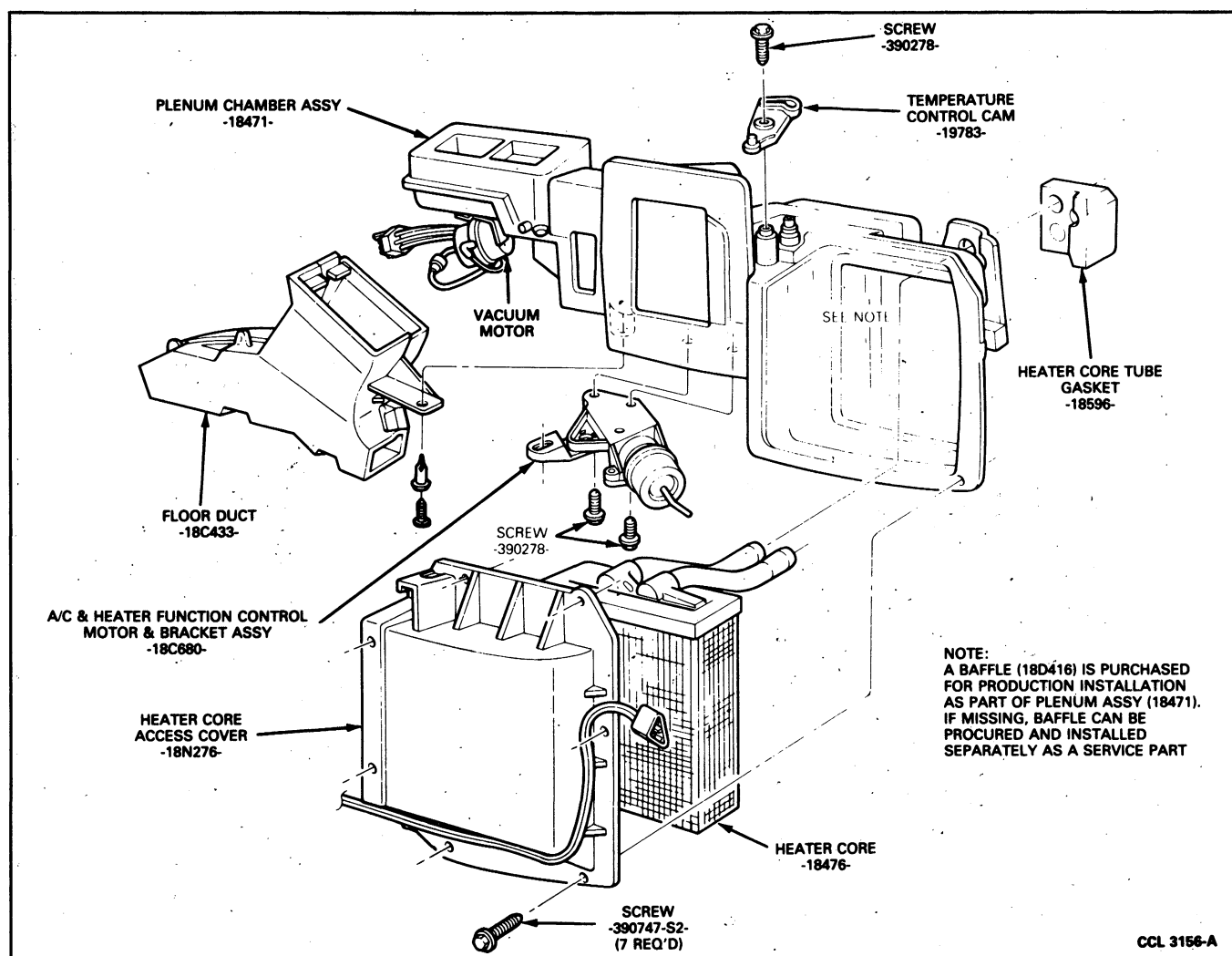
It includes the control head with one cable operated lever for selecting temperature. A second lever moves a vacuum selector switch that activates the various function doors and A/C electrical contacts. A third lever moves electrical switch contacts so that they establish continuity for one of four available blower switch positions between LOW and HI speed.

### Electrical System

The electrical system consists of the blower motor, blower speed switch, blower resistor with a thermal limiter, pressure switch, magnetic clutch and the fuse and wiring to complete the circuits (Fig. 17).

The blower motor is installed in the blower housing which is part of the evaporator case. The motor is connected to the electrical circuit with one hardshell connector located near the motor.

The blower speed switch is installed on the control assembly and, with the blower resistor, provides the selection of four blower operating speeds.



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FIG. 9 Plenum Assembly—Disassembled View

The blower motor resistor is installed in the evaporator case between the blower motor and the evaporator core.

The resistor assembly also contains a thermal limiter which is used as a temperature-protecting fuse. The thermal limiter is located a preset distance from the resistor coils (Fig. 6). If the temperature of the thermal limiter reaches approximately 121°C (250°F), the limiter contacts will open, interrupting the blower motor circuit for all blower speeds except high speed. The thermal limiter will not reset and the resistor assembly must be replaced if the thermal limiter opens.

The pressure switch is located on the side of the suction accumulator and controls the compressor clutch cycling. When the evaporator pressure increases to approximately 276-324 kPa (40-47 psi), the switch closes. When the pressure drops below approximately 169 kPa  $\pm$  10 kPa (24.5 psi  $\pm$  1.5 psi), the switch opens to stop compressor operation. In ambient temperatures below approximately 7.2°C (45°F), the pressure switch will not allow compressor operation because of low system pressures.

### Vacuum System

The VENT/HEAT, FLOOR/DEFROST, and OUTSIDE RECIRC. doors are vacuum operated. Refer

to the vacuum logic diagram in Figs. 2 and 3 for vacuum motor actuation sequence.

For maximum cooling, the temperature lever should be set to the extreme left; the function lever should be in the MAX A/C position; and the blower should be set for a desired rate of airflow.

Even though the function lever is on MAX A/C, the temperature lever, being manually controlled, may be set to modify the temperature of the air and the path through which the air flows. Another characteristic of the MAX A/C setting is the increased noise level of the blower. Blower speed does not change when the outside air/recirc door is moved to either of its two positions. The difference in noise level is that an open recirc door exposes the passenger compartment directly to the noise. When insulated against the noise with the recirc passageway closed, the blower speed appears to be less.

The control lever operates a vacuum valve (Fig. 18) which is attached to the backside of the control assembly by two screws.

Two hoses extend from the valve to the vacuum motors and vacuum supply. The solid black hose goes to the vacuum supply through a tee shaped check valve, which attaches the vacuum reservoir and engine source. The white hose actuates the OUTSIDE/

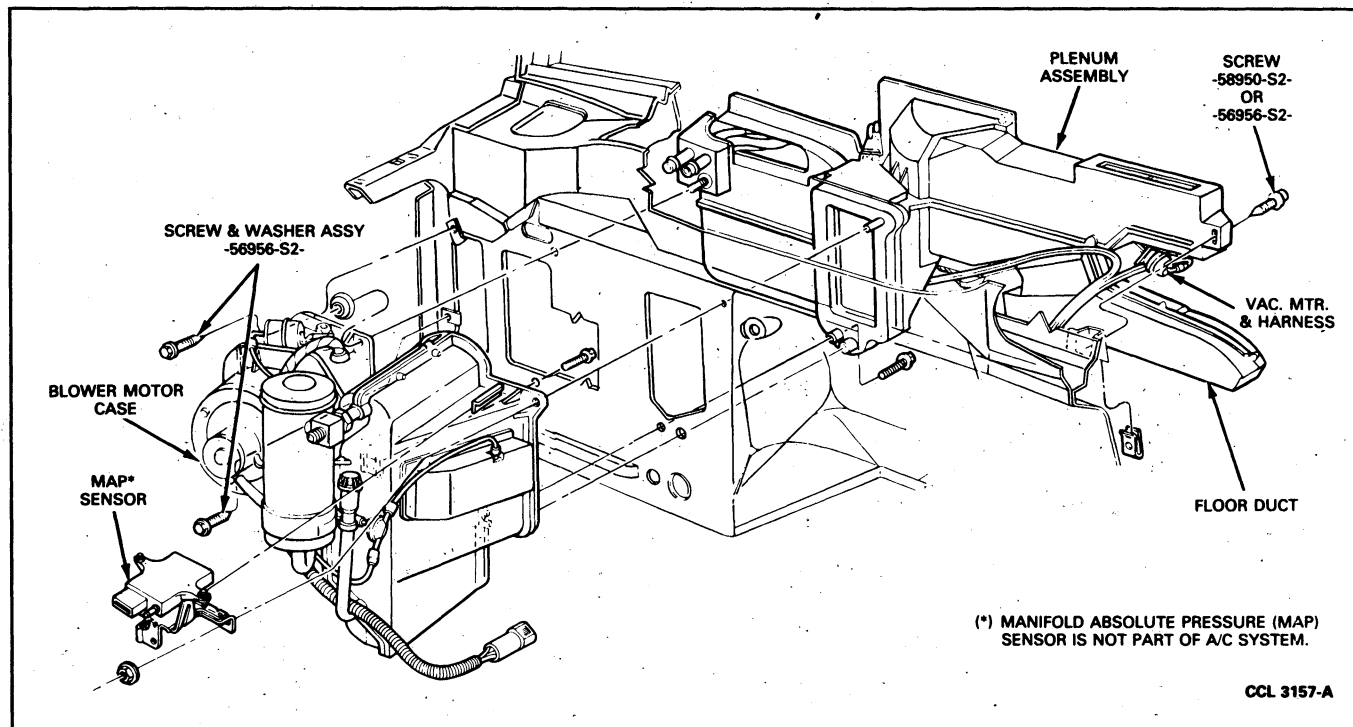


FIG. 10 Assembly of Evaporator Case and Plenum Assemblies

RECIRC air door two-position vacuum motor. The blue hose actuates the VENT/HEAT air door two-position vacuum motor. The red and yellow hoses actuate the FLOOR/DEFROST three-position air vacuum motor. Each end of each hose slides onto the nipple of the vacuum port to which it attaches.

### Refrigerant System

The manual A/C-heater refrigerant system uses a six-cylinder swash plate compressor, a condenser, an evaporator core with a fixed orifice in the evaporator inlet tube, a suction accumulator with an integral drier, a pressure switch, Schrader-type service access gauge port valves, and the necessary refrigerant lines.

### A/C Compressor and Clutch Assembly

The A/C compressor is the 10-cylinder swash-plate type and is installed on the LH side of the engine compartment. It is driven by the front end accessory drive VEE belt. Belt tension adjustment is obtained by means of an automatic tensioner (on gasoline engines or by moving the compressor and braces on 7.3L diesel engines) (Fig. 19).

### Pressure Relief Valve

A pressure relief valve is installed on the compressor discharge manifold to relieve excess high pressure buildups (310 kPa or 450 psi and above) and prevent damage to the compressor and other A/C components.

### Condenser Assembly

The condenser assembly is attached to the radiator support in front at the radiator with two mounting brackets at the top and bottom of the condenser (Fig. 20). The top mounting brackets attach to the rear side of the radiator support and the lower brackets attach to the front side of the radiator support.

### Evaporator Core

The evaporator core is a "flooded type" (plate-fin) core similar to passenger car cores (Fig. 21). The liquid line connects to the bottom of the core and the suction accumulator/drier assembly connects to the top of the core.

### Fixed Orifice Tube

The evaporator inlet tube is fitted with a fixed orifice to control refrigerant flow. This orifice tube can be removed from the evaporator core inlet tube for placement if it becomes necessary. However, Orifice Tube Remover and Installer T83L-19990-A (Motorcraft YT-1008) or equivalent (Fig. 22) is necessary to prevent breakage when removing the tube.

The fixed orifice tube assembly is a restriction between the high and low pressure refrigerant and meters the flow of liquid refrigerant into the evaporator core. The diameter of the orifice within the orifice tube is 1.575mm (0.062 inch). The orifice tube can be identified by the RED body color with a white outlet tip.

The fixed orifice tube is located in the evaporator inlet tube and has filter screens on the inlet and outlet ends of the tube body. The filter screens act as strainers for the liquid refrigerant flowing through the fixed orifice opening. O-rings on the tube body prevent the high pressure liquid refrigerant from bypassing the orifice. Adjustment or repairs cannot be made to the fixed orifice tube assembly and it must be replaced as a unit.

### Suction Accumulator/Drier

The suction accumulator/drier (Fig. 18) is mounted inside the evaporator case and attaches directly to the evaporator outlet tube.

Refrigerant enters the accumulator/drier canister through the inlet tube and the heavier, oil-laden refrigerant falls to the bottom of the canister. A small diameter oil bleed hole is located in the side of the

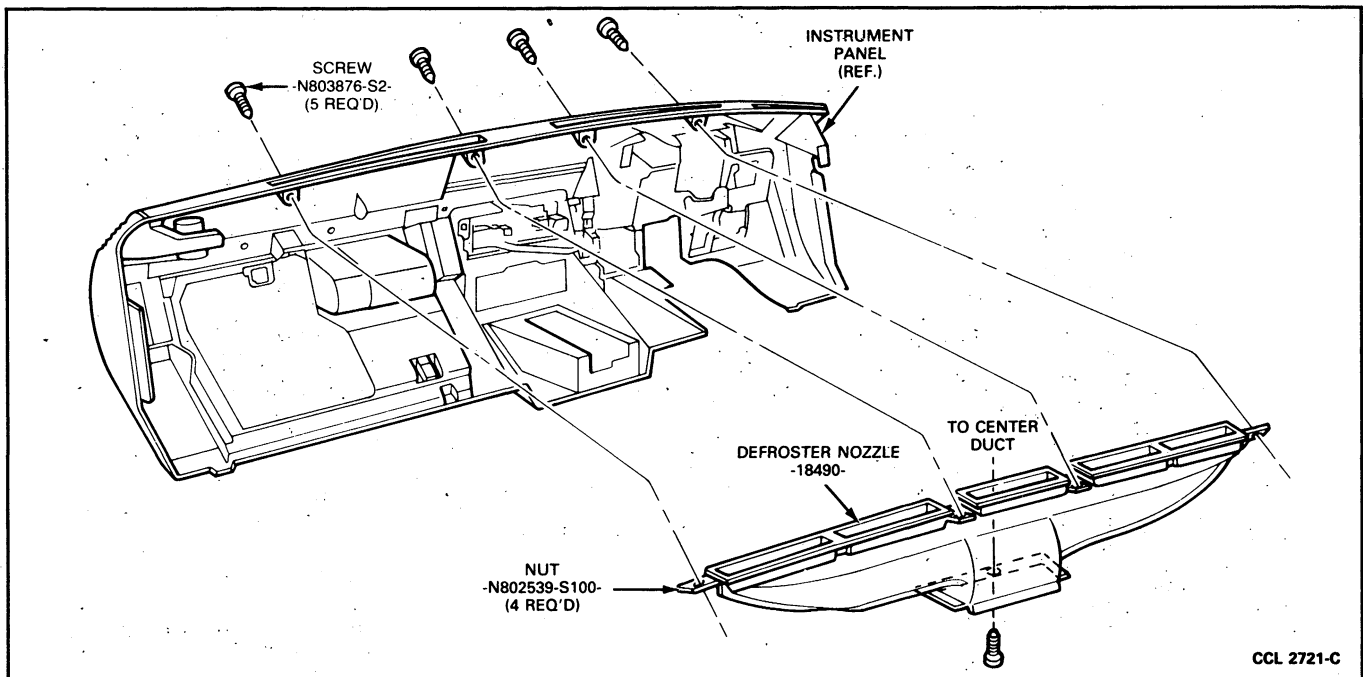


FIG. 11 Defroster Nozzle

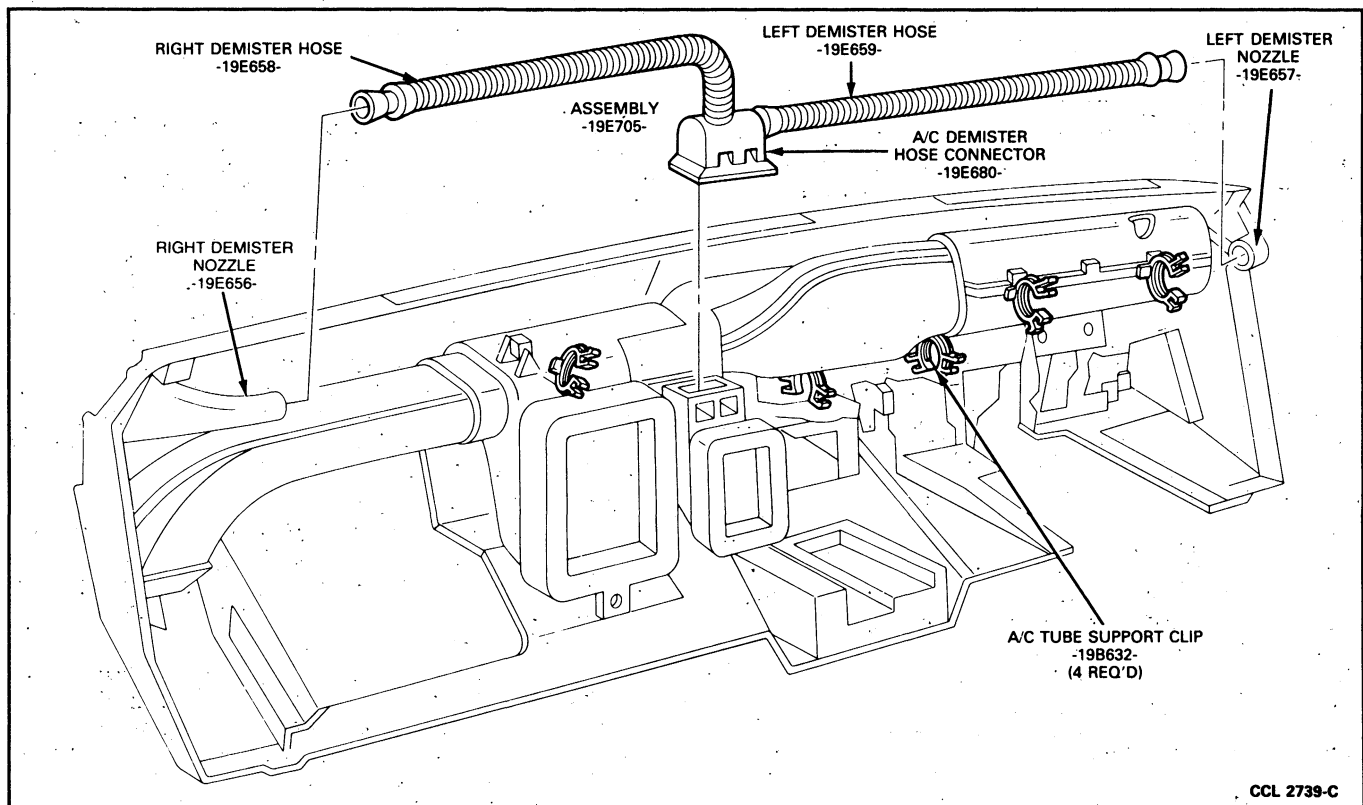


FIG. 12 Demister Nozzles and Hoses

outlet tube near the bottom of the canister. This bleed hole is covered with a filter screen and allows a small amount of the heavier liquid refrigerant and oil mixture to re-enter the suction line at a controlled rate. When the heavier liquid refrigerant and oil mixture enters the compressor suction line, it has a second opportunity to vaporize and circulate through the compressor without

causing damage to the compressor due to refrigerant slugging.

A desiccant bag is mounted inside the suction accumulator/drier canister to absorb any moisture which may be in the refrigerant system.

A fitting located on the top or side of the canister is used to attach the clutch cycling pressure switch. A long-travel Schrader-type valve stem core is installed in

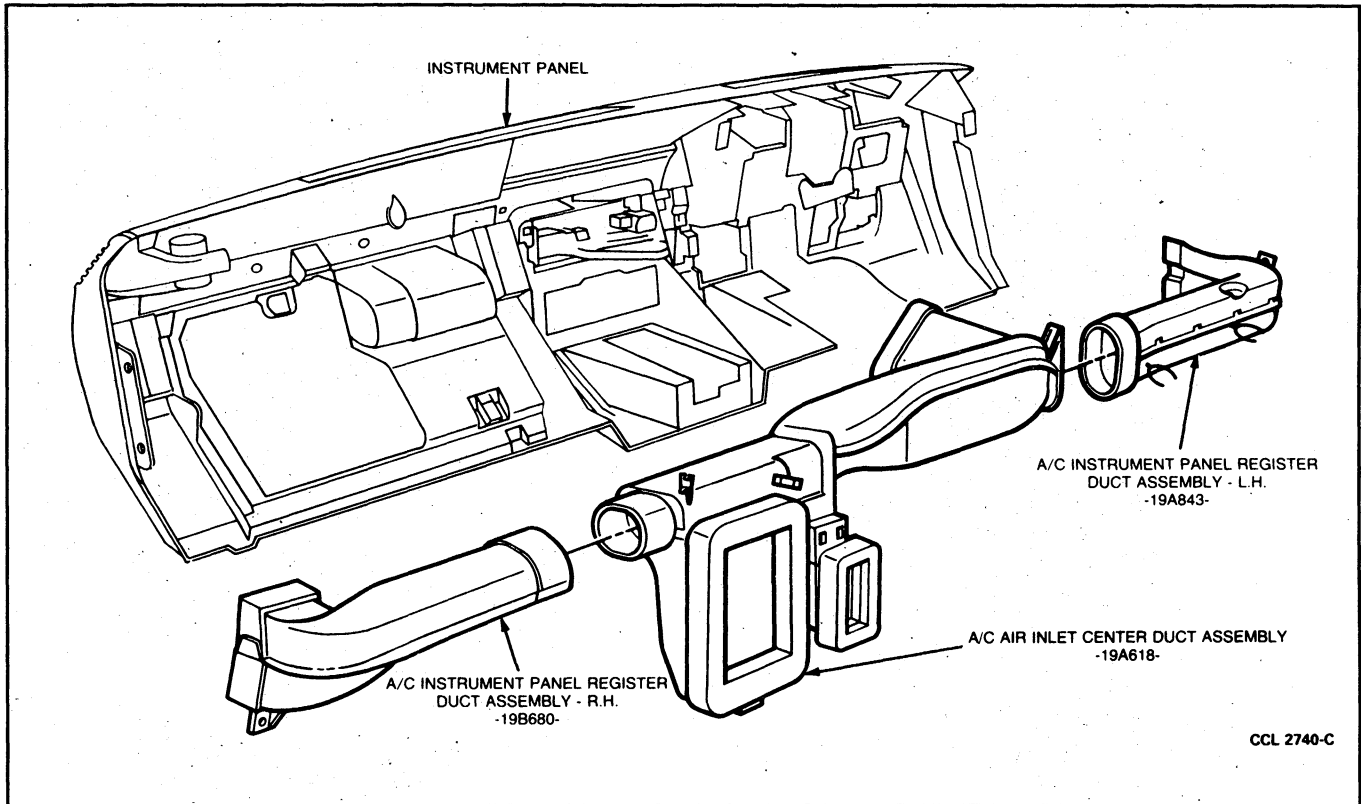


FIG. 13 Instrument Panel Register Duct

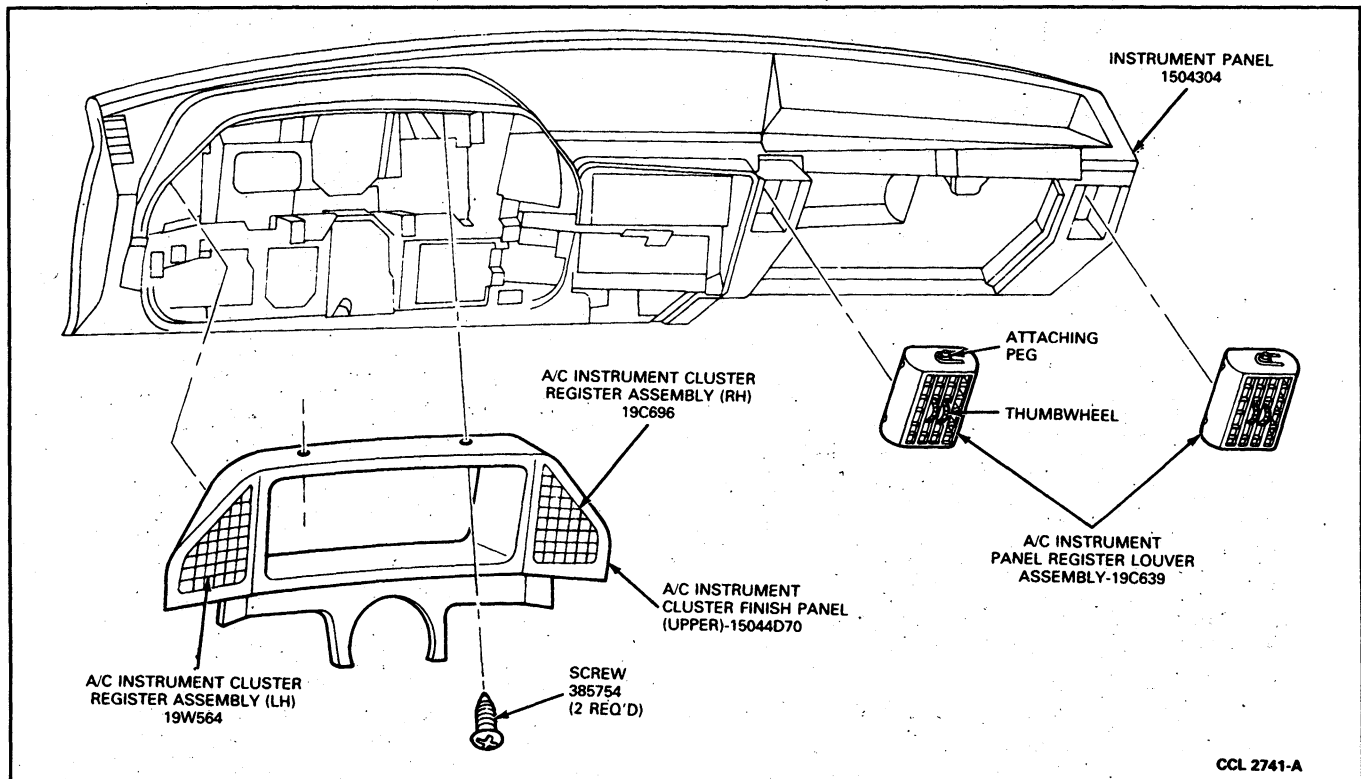


FIG. 14 Instrument Panel Registers

the fitting opening to prevent refrigerant loss when the clutch cycling pressure switch is removed.

If it is necessary to check the suction accumulator/drier for excessive refrigerant oil, the oil must be poured

from the accumulator through the pressure switch fitting when the Schrader valve stem is removed.

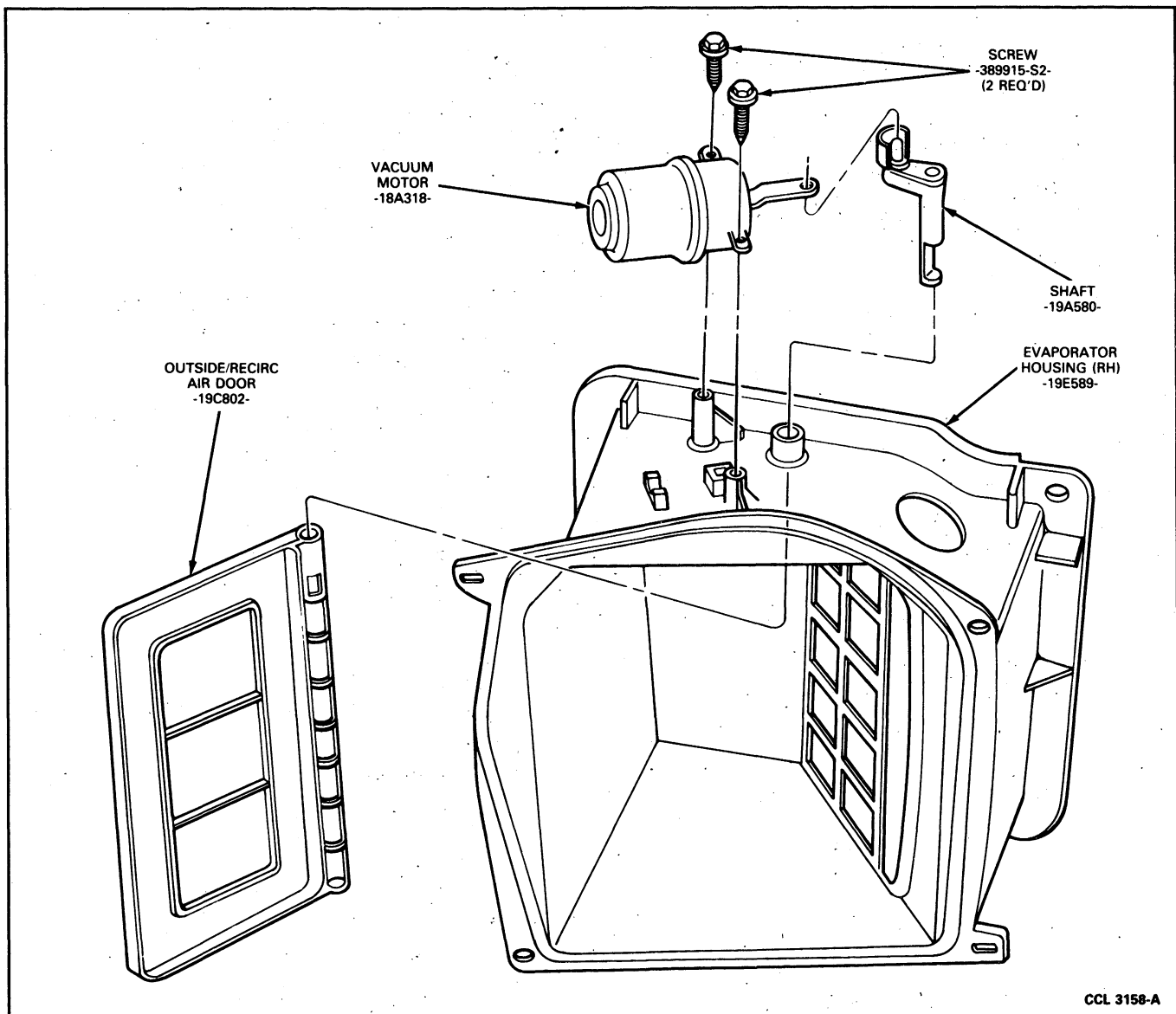


FIG. 15 Outside Air/Recirc Air Vacuum Control

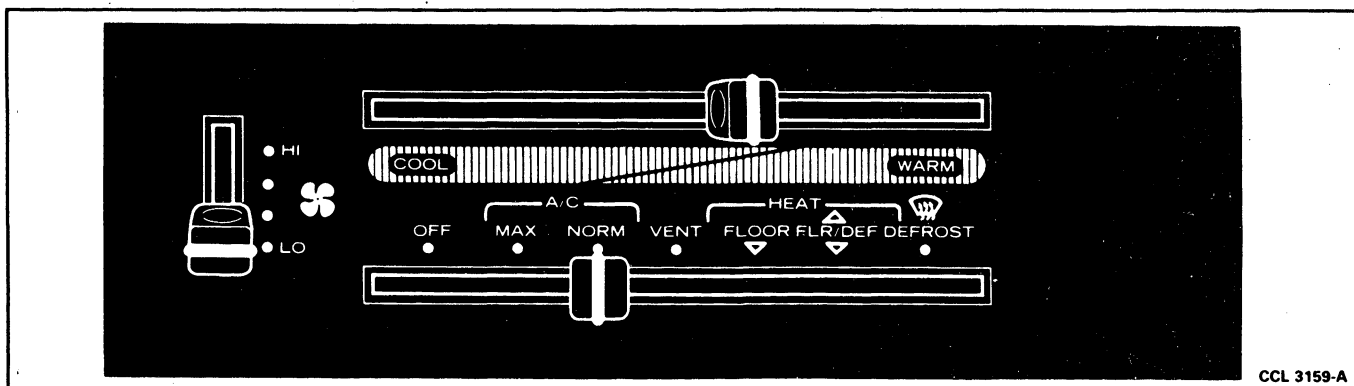


FIG. 16 Control Assembly (Front View)

### Replacement Guidelines

#### Replace Accumulator/Drier when:

- The suction accumulator/drier is restricted, plugged or perforated.
- The system has been left open for more than 24 hours (system completely discharged).
- There is evidence of moisture in the system (i.e., internal corrosion of metal lines or dark thick refrigerant oil).

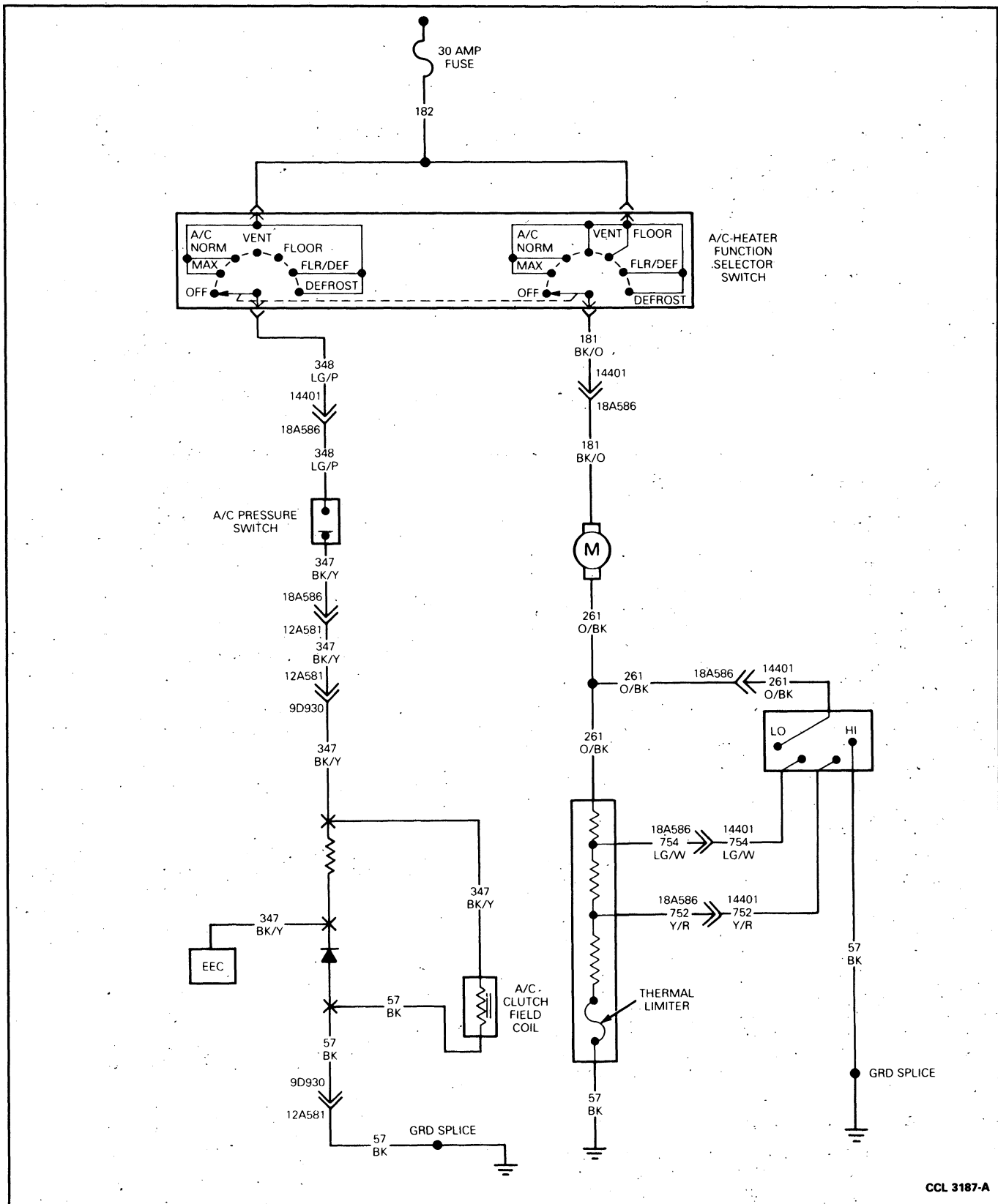


FIG. 17 Manual A/C-Heater Electrical System Wiring Diagram

- A component such as a condenser, evaporator, refrigerant line or a seized compressor is replaced. (Flush system and replace orifice tube when replacing a seized or damaged compressor.)

**Do not replace Accumulator/Drier every time if:**

- There is a partial loss of refrigerant charge.
- A dent is found in the outer shell of the suction accumulator/drier.

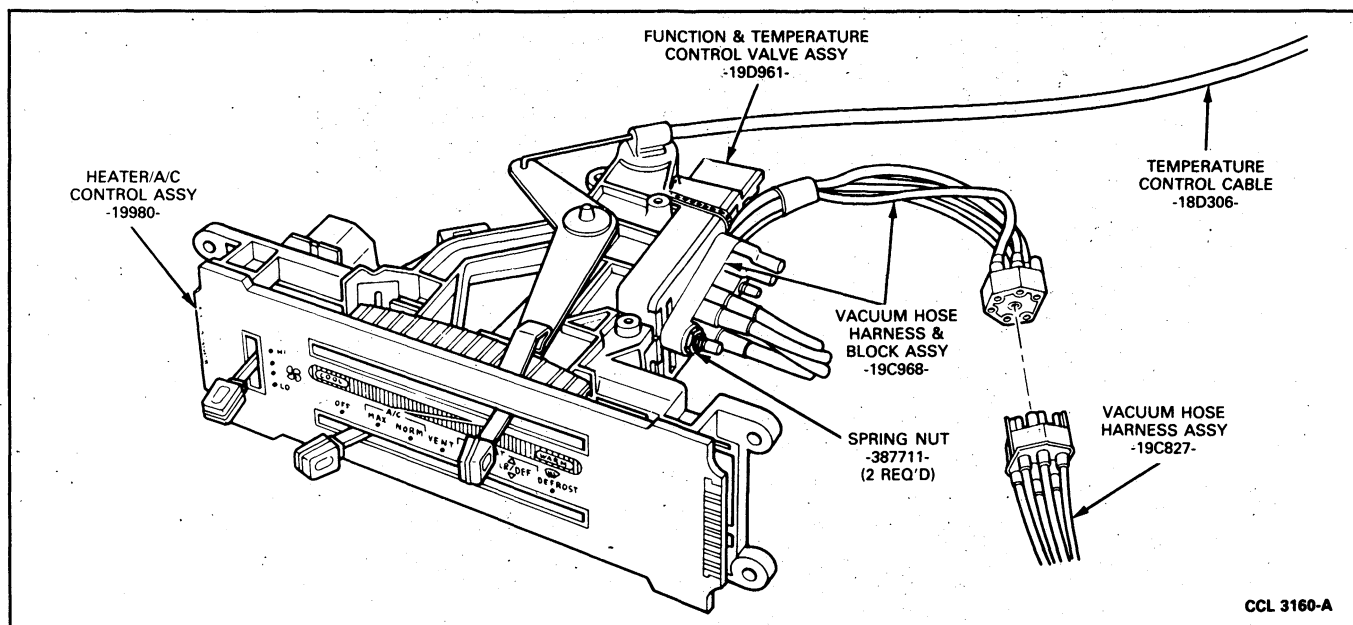


FIG. 18 Vacuum Selector Valves and Hoses

### Clutch Cycling Pressure Switch

The clutch cycling pressure switch (Fig. 23) is mounted on a Schrader valve-type fitting on the side of the suction accumulator/drier assembly. A valve depressor, located inside the threaded end of the pressure switch, presses in on the Schrader valve stem as the switch is mounted and allows the suction pressure inside the accumulator/drier housing to activate the switch. The electrical switch contacts are normally open when the suction pressure is at or below 179 kPa (26 psi); they will close, activating the compressor clutch, when the suction pressure rises to approximately 310 kPa (45 psi) or above. Lower ambient temperatures (below approximately 7°C or 45°F) during cold weather seasons will also open the clutch cycling pressure switch contacts, because of the pressure/temperature relationship of the refrigerant in the system. The electrical switch contacts control the electrical circuit to the compressor's magnetic clutch coil. When the switch contacts are closed, the clutch coil is energized and the A/C clutch is engaged to drive the compressor. When the switch contacts are open, the compressor's magnetic clutch coil is de-energized, the A/C clutch is disengaged and the compressor does not operate. The clutch cycling pressure switch, when functioning properly, will control the evaporator core pressure at a point where the plate-fin surface temperature will be maintained slightly above freezing which prevents evaporator icing and the blockage of airflow.

### Service Access Gauge Port Valves

Two service access gauge port valves are used in the refrigerant system. The high pressure (discharge) valve is located in the discharge line near the condenser (Fig. 24). This service access gauge port valve requires High Pressure Service Port Adapter Set D81L-19703-A (Motorcraft YT-354 or 355) or equivalent (Fig. 25) to connect a manifold gauge set or charging station to it. The other service access gauge port valve is located on the side of the suction accumulator and is used to measure evaporator pressure. An additional Low Pressure Gauge Port Valve adapted to the accumulator

is available for attaching a service hose and pressure gauge. See Tee Adapter Tool Installation in Section 36-30.

### Refrigerant Lines

On vehicles equipped with gasoline engines, the manifold and suction/discharge tubes are serviced as an assembly.

On vehicles equipped with diesel engines, the manifold and suction/discharge tubes are serviced separately.

The compressor discharge line has a Schrader-type service access gauge port valve located near the condenser. This is the high pressure service port. A High Pressure Service Port Adapter Set D81L-19703-A (Motorcraft YT-354 or 355) or equivalent is necessary to connect a manifold gauge set or a charging station to this service port.

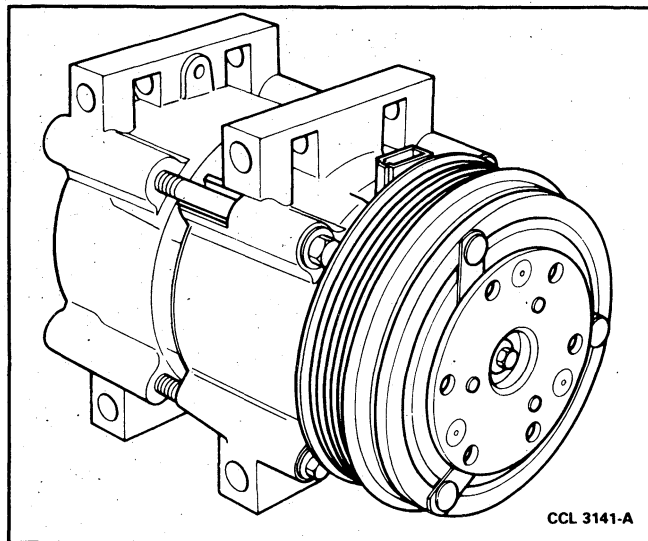


FIG. 19 FX-15 Compressor Assembly



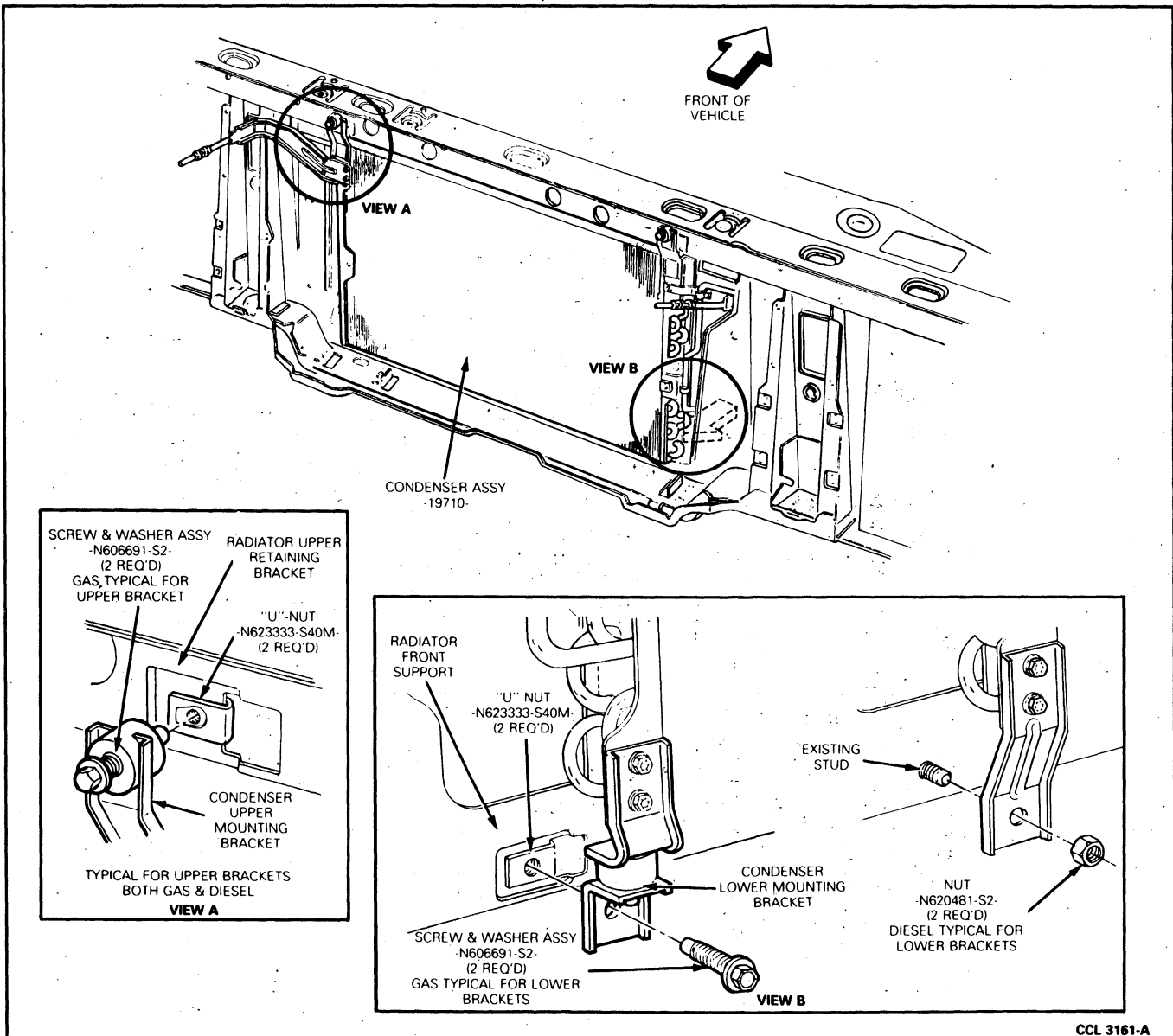


FIG. 20 Condenser Assembly

## DIAGNOSIS AND TESTING

For instructions and illustrations covering diagnosis and testing of the heater and A/C systems used on current F-Series and Bronco vehicles, refer to Sections 36-10 and 36-30.

- Heating system coverage includes the following:
  - Blower motor current draw test
  - Blower motor voltage test
  - Blower switch continuity test
  - Heater core leak testing
  - Loose blower wheel test
  - Open circuit test

Procedures are also provided for bleeding air from the heater core, visually checking the blower, and backflushing the heater core.

- A/C system coverage includes the following:
  - A/C performance testing

—Magnetic clutch test

—Pressure switch test

Procedures are also provided for leak testing, making visual inspections, and using a manifold gauge set.

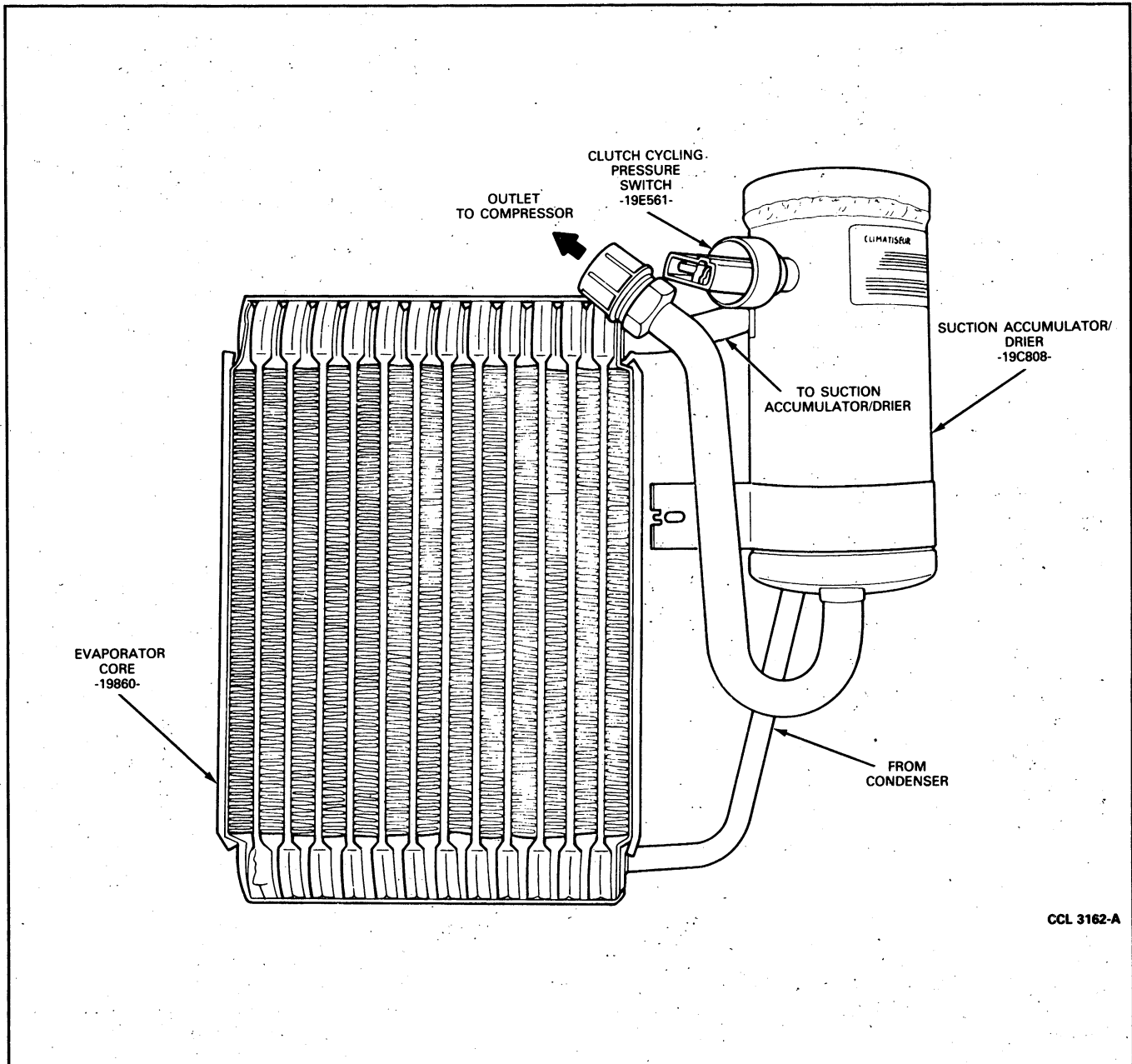
## ADJUSTMENTS

### Vacuum Controls and Temperature Control Cables

To check for proper functional control in the system, move the blower switch to HIGH. Then, move the function lever to each of its seven positions. There should be airflow from the appropriate registers, floor duct and/or nozzles and no airflow in the OFF position.

If proper airflow is not provided, look for the following:

- A vacuum harness which is not fully seated at the vacuum motor.
- A damaged connector between the control assembly and plenum.



**FIG. 21 Evaporator Core and Suction Accumulator/Drier**

- A damaged connection between the plenum and vacuum source.

vacuum input from the engine.

- A vacuum harness which is pinched or trapped.
- A transposed vacuum line. This condition is evident when the color code on the vacuum line fails to match the color code on its mating vacuum nipple.

movement of the damper door when vacuum is applied or vacuum is removed.

- An inoperative vacuum selector valve.

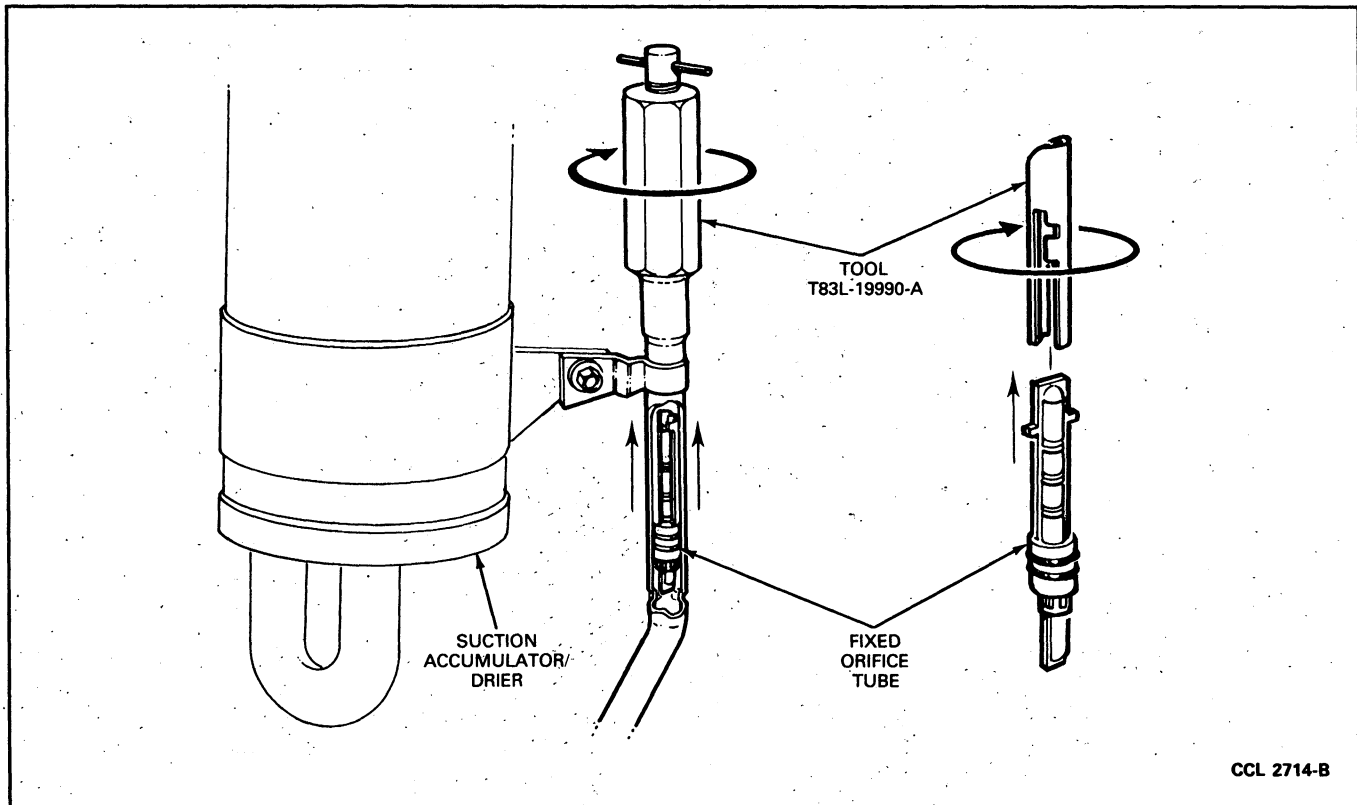
To check the temperature control cable adjustment, move the temperature control lever back and forth, checking for the sound of the temperature blend door seating against the stop. If the sound of the door seating is not heard before the lever reaches its limit of travel, the temperature control cable may be

misadjusted or not connected. Refer to Cable Adjustment or Cable Removal and Installation.

**NOTE:** If the temperature lever does not move left or right and appear to be locked in place, the adjustment pin may have been inadvertently left in the cam during assembly.

To remove temperature control cam adjustment pin:

1. Disengage glove compartment door by squeezing side with stop and removing pin holding check strap from opposite side. Allow door to hang free.
2. Working through glove compartment opening, remove red assembly pin from control cam with a mechanical fingers tool or a wire with a hook on the end.
3. Check for proper control cable operation.
4. Install glove compartment and door.



**FIG. 22 Removal of Fixed Orifice Tube**

To adjust the temperature control cable, proceed as follows:

1. Disengage glove compartment as outlined. Allow door to hang free.
2. Working through glove compartment opening, remove cable jacket from metal attaching clip on top of plenum by depressing clip tab and pulling cable up.

**NOTE:** Cable end should remain attached to door cam and/or crank arm.

3. Set temperature control lever to COOL and hold firmly.
4. With cable end attached to temperature door cam, push gently on cable jacket to seat blend door (push until resistance is felt). Install cable into clip by pushing cable jacket into clip from top until it snaps into place (Fig. 26).
5. Operate system to check temperature control.

#### Compressor Drive Belt Tension

For compressor drive belt adjustment procedures, refer to Section 27-06, Accessory Drive Belt Service.

## REMOVAL AND INSTALLATION

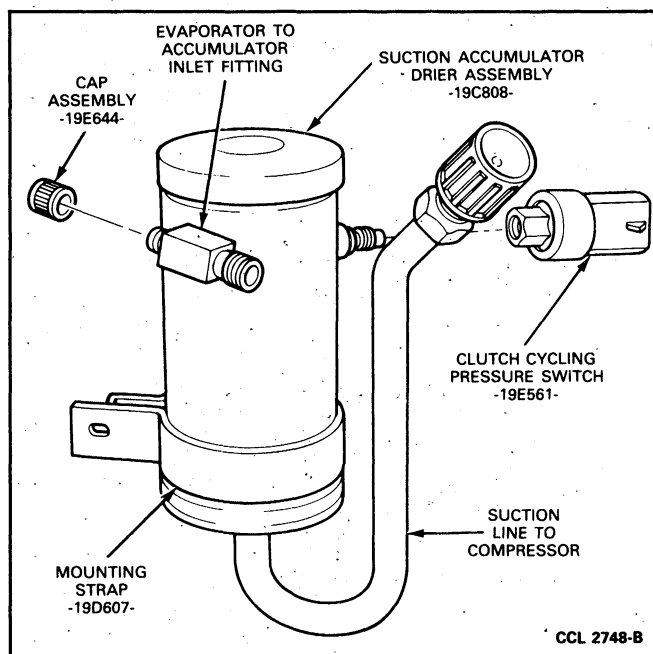
### Control Assembly

1. Disconnect the battery ground cable(s).
2. Pull the center finish panel away from the instrument panel to gain access to the four screws which attach the control assembly to the instrument panel. Refer to Section 45-61 for the position of the instrument panel assembly and its components.

3. Remove the four screws. Then, pull the control assembly far enough through the opening in the panel to allow disengagement of the electrical connectors for the blower switch and control illumination lamp.
4. Disconnect the vacuum harness connector from the vacuum selector valve on the control assembly.
5. Disconnect the vacuum harness from the plenum assembly connector.
6. Using a screwdriver or needlenose pliers, carefully release the temperature control snap-in flange from the underside of the control assembly (Fig. 27).
7. Rotate the control assembly 90 degrees and disconnect the temperature control cable from the temperature control lever.
8. Move the control assembly away from the instrument panel.

### Installation

1. Pull the temperature control cable through the control assembly opening in the instrument panel for a distance of approximately 203mm (8 inches).
2. Hold the control assembly against the instrument panel with the face of the control directed toward the roof of the vehicle. Attach the temperature cable to its control lever.
3. Rotate the control assembly to position it into the instrument panel opening. Snap the cable flag into the control bracket. Be sure that the flag is firmly seated.



**FIG. 23 Suction Accumulator/Drier—Cutaway View**

4. Connect the wire harness to the blower switch and control illumination lamp. Attach the vacuum harness to the vacuum selector valve and plenum.
5. Position the control assembly into its instrument panel opening while being careful that the vacuum and electrical harness are properly stowed.
6. Install the finish panel.
7. Connect the battery ground cable(s).
8. Check the system for proper operation.

### Blower Speed Switch

#### Removal

Refer to Fig. 28.

1. Carefully pry instrument panel center finish panel out of its four lower retaining slots. Then, rotate panel out of upper slot.
2. Remove control assembly from instrument panel, as outlined.
3. Remove knob from blower switch by placing a small screwdriver between knob spring retainer and control assembly. Then, pull on screwdriver, applying pressure on spring retainer and pull knob from switch.
4. Remove four control assembly attaching screws.
5. Move control assembly away from instrument panel opening and disconnect wire connector from switch.
6. Remove screw attaching switch to bottom of control assembly, and remove switch.

#### Installation

1. Position switch on control assembly and install attaching screw.
2. Connect wire connector to switch.
3. Position control assembly in instrument panel and attach it with four screws.

4. Install blower switch lever knob with spring retainer pushed into place.
5. Slide instrument panel center finish panel upper retainer into slot in the instrument panel. Press remaining four retainers into mating slots in the panel.
6. Check blower switch for proper blower motor operation.

### Vacuum Selector Valve

#### Removal

1. Disconnect battery ground cable(s).
2. Remove control assembly as outlined. Do not disconnect electrical cable.
3. Remove two screws attaching vacuum selector valve to control assembly and remove selector valve (Fig. 29).
4. Remove two nuts which secure vacuum harness to the selector valve, and remove harness.

#### Installation

1. Install vacuum harness on vacuum selector valve.
2. Position the vacuum selector valve over its mounting location on the control assembly. Align the holes and install two attaching screws.
3. Connect vacuum harness at the plenum. Be certain that the locking tabs are engaged.
4. Position the control assembly in its instrument panel opening. Be sure the electrical and vacuum harnesses are properly stowed. Install the four attaching screws (Fig. 27).
5. Connect the battery ground cable(s).
6. Start the engine to provide vacuum. Then, move the function lever to each of its operating positions to verify that vacuum is being distributed properly through the selector valve to the applicable vacuum motor.

### Temperature Control Cable

#### Removal

1. Remove the control assembly from the instrument panel as outlined.
2. Disengage the glove compartment by squeezing the side with stop and removing pin retaining check strap from outside. Allow glove compartment to hang free.
3. Working through the glove compartment, remove the temperature control cable housing from the clip on top of plenum by depressing the clip tab and pulling the cable rearward. Refer to Fig. 30.
4. Working from the bottom of the control with a screwdriver or needlenose pliers, carefully release the temperature control cable snap-in flag.
5. Rotate control assembly face 90 degrees upward. Disconnect the temperature control cable and move the control assembly away from the instrument panel.
6. Disconnect the temperature control cable from cam on top of the plenum.
7. Pull cable away from instrument panel and through the control assembly opening.

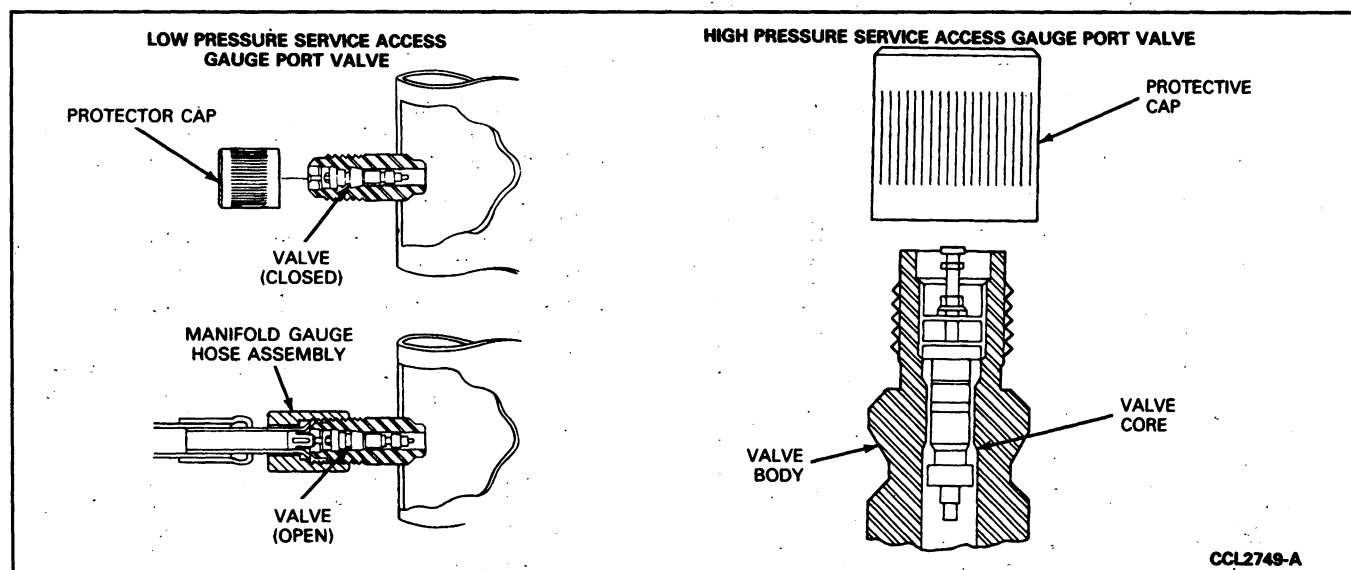


FIG. 24 Service Access Gauge Port Valves

### Installation

1. Feed wire loop end of cable through control assembly opening in instrument panel.
2. Attach wire loop end of cable to the temperature cam assembly on top of the plenum. Ensure that the wire loop coil is up and that the cable is routed under cable hold-down on cam assembly.
3. Hold control assembly with its top toward the steering wheel. Attach the temperature control cable to temperature control lever. Snap flag into the top of the control assembly bracket.
4. Position the control assembly close to the opening in the instrument panel. Working through this opening, route the cable so that it will not have kinks or sharp bends anywhere along its course between the control assembly and the cam on the plenum.
5. Adjust cables as outlined.
6. Actuate the temperature control lever and check for proper cable adjustment. Adjust as necessary.
7. Connect wire and vacuum harness to control assembly and plenum.
8. Install the control assembly in the instrument panel using four attaching screws.
9. Check system for proper operation.
10. Complete installation of the control assembly and glove compartment.

### Temperature Control Cam

#### Removal

1. Disengage glove compartment door by squeezing the side with stop and removing pin retainer check strap from opposite side. Allow door to hang free.
2. Working through glove compartment opening, remove temperature control cam retaining screw and lift cam away from plenum.
3. Move cam as necessary, to disconnect the temperature control cable and remove cam from the vehicle (Fig. 31).

### Installation

1. Connect temperature control cable to temperature control cam. Ensure that the cable is routed under the cable retainer on cam.
2. Position the temperature control cam on top of the plenum and install retaining screw.
3. Check operation of cam for a full range of temperature control. Adjust the temperature control cable, as necessary.

### Instrument Panel

Procedures for removal and installation of the instrument panel are covered in Section 45-61.

### Defroster Nozzle

#### Removal

1. Loosen instrument panel and pull it back far enough to gain access to defroster nozzle screws. Refer to Section 45-61 for instrument panel procedures.
2. Remove four screws attaching defroster nozzle to the underside of the instrument panel (Fig. 32).
3. Remove screw attaching defroster nozzle inlet to center duct.
4. Pull defroster nozzle rearward clearing mounting tabs. Lift defroster nozzle out.

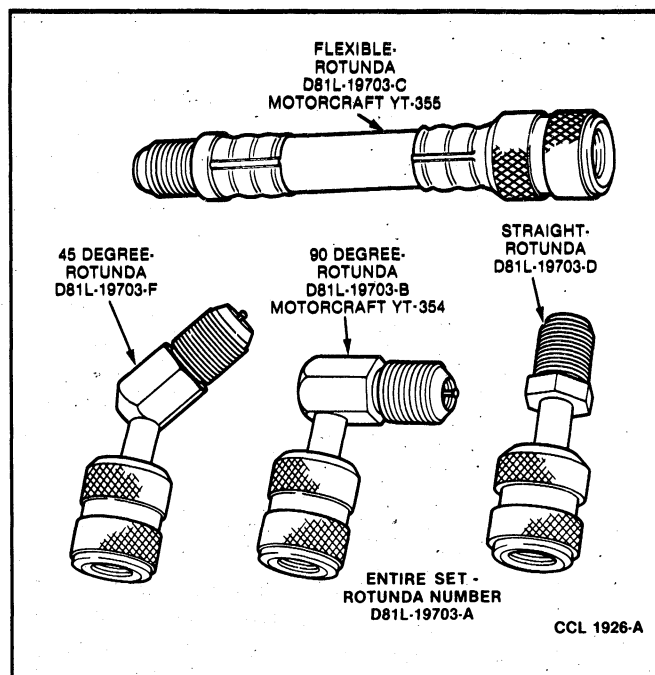
#### Installation

1. Position defroster nozzle in underside of instrument panel and install four retaining screws.
2. Install instrument panel as outlined in Section 45-61.
3. Install defroster inlet retaining screw.

### Demister Nozzles and Hoses

#### Removal and Installation

1. Remove instrument panel as outlined in Section 45-61.
2. Remove two nuts attaching RH and LH demister nozzles to instrument panel. They are located in



**FIG. 25 Service Access Gauge Port Valve Adapters**

opposite corners of the panel. Disconnect flexible hose which slides over the input end of each nozzle (Fig. 33).

3. A connector which slides over a slip joint opening in the center duct receives the opposite end of each of the demister hoses. The hose to the left demister nozzle slides over a neck on upper surface of the connector. The hose on the right demister nozzle slides over a neck on onboard surface of the connector. To disconnect a hose, pull it off connector and/or demister nozzle.
4. To install nozzles, hoses, and/or connector, install two attaching screws into each nozzle. Then, slide all removed demister hoses over their attaching locations.
5. Install instrument panel as outlined in Section 45-61.

## Floor Duct

### Removal and Installation

1. Remove the plastic attaching screw from the bottom side of the plenum.
2. Remove the push nut sleeve from the attaching hole.
3. Disengage the floor duct from the plenum (Fig. 34).
4. To install, position the duct on the plenum and engage the lugs inside the duct with their mating slots in the plenum. Tilt the duct into place, then push in to secure engagement.
5. Start the plastic screw into the push nut sleeve. Then, install through the floor duct flange and into the attaching hole in the plenum. Be sure that the attachment is secure.

## Heater Core

### Removal

1. Allow the engine to cool. Observe the safety precautions outlined in Section 27-02, Cooling System Service, then, proceed as follows:
  - Place a thick cloth over the radiator cap.
  - Turn the cap slowly to its first stop to release system pressure.
  - When the pressure has been released, tighten the radiator cap.
2. Disconnect the heater hoses from the heater core tubes. Plug the hoses.
3. Remove the glove compartment.
4. From inside the passenger compartment, remove the seven screws which attach the heater core access cover to the plenum. (Fig. 35).
5. Disconnect the vacuum source. Leave the vacuum harness attached to the cover. Remove the cover.
6. Remove the heater core from the plenum.

### Installation

1. Position the heater core and seal in the plenum assembly.
2. Install the heater core access cover on the plenum assembly and secure it with its seven attaching screws. Be certain that the vacuum harness is not trapped or pinched during the cover installation.
3. Connect the vacuum harness to its source connection.
4. Install heater hoses on the heater core tubes at dash panel in engine compartment. Do not overtighten the hose clamps.
5. Check coolant level and add coolant as required. Refer to Section 27-02, Cooling System Service.
6. Check system for proper operation and coolant leaks.

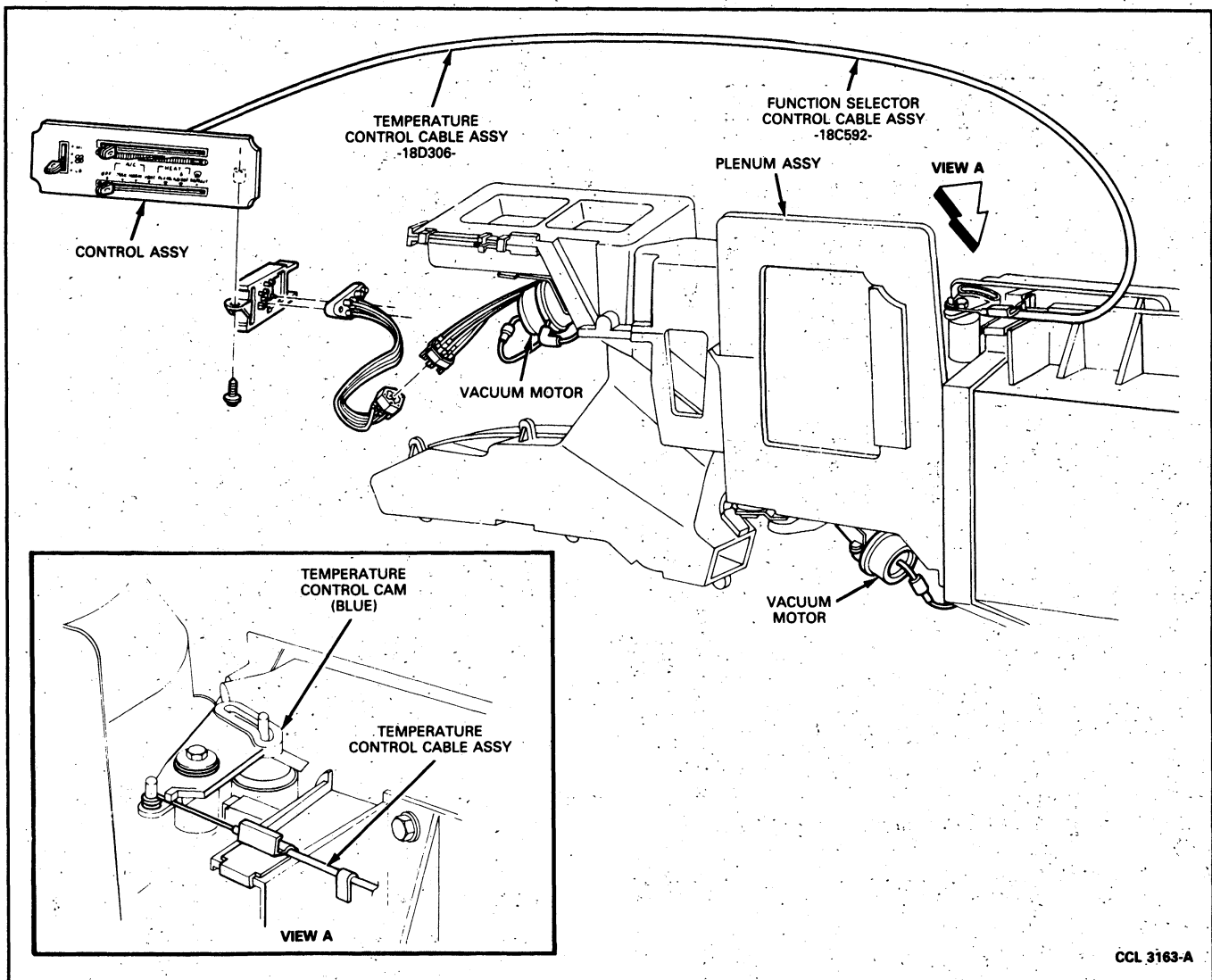
## Register Ducts

### Removal

1. Disconnect ground cable from battery negative terminal.
2. Remove instrument panel as outlined in Section 45-61.
3. Rotate instrument panel rearward as far as necessary to permit removal of register ducts from panel.
4. Remove defroster nozzle.
5. Remove register duct attaching screws. Remove the duct (Fig. 36).

### Installation

1. Position register ducts in instrument panel and install the attaching screws (Fig. 36).
2. Install defroster nozzle.
3. Rotate instrument panel forward and install as outlined.
4. Connect battery ground cable.



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FIG. 26 Control Cable-To-Cam Connection

**Register Louver Assembly****Passenger Side****Removal**

1. Insert tool with thin blade under retaining tab (Fig. 37). Pry retaining tab toward louvers until retaining tab pivot clears hole in register opening.
2. Pull register louver assembly end out from housing only enough to prevent pivot from going back into pivot hole.
3. Repeat Step 1 for other retaining tab and pull register louver assembly from register opening.

**Installation**

NOTE: The pivots on each end of the register louver assembly are different diameters and therefore determine the installed position of the register louver assembly.

1. Position register louver assembly into opening with largest diameter pivot near largest pivot hole.
2. Depress retaining tabs and push register louver assembly into register opening. Then, engage retainer tab pivots in pivot holes.

**Register Louver Assembly (Driver's Side Only)****Removal and Installation**

1. Remove the right and left instrument panel cluster finish panels located on each side of the steering column.
2. Remove the instrument panel cluster opening upper finish panel.

NOTE: Refer to Section 45-61 for instrument panel removal and installation.

3. Refer to Fig. 38.
4. If both louvers are being replaced, remove the staked-over finish panel material from the two stud locations on the backside of each panel which are called out as Point "A".
5. Remove the barrel clip from the stud located at the lower, outer corner of each register called out as Point "B".
6. Remove the louvers.

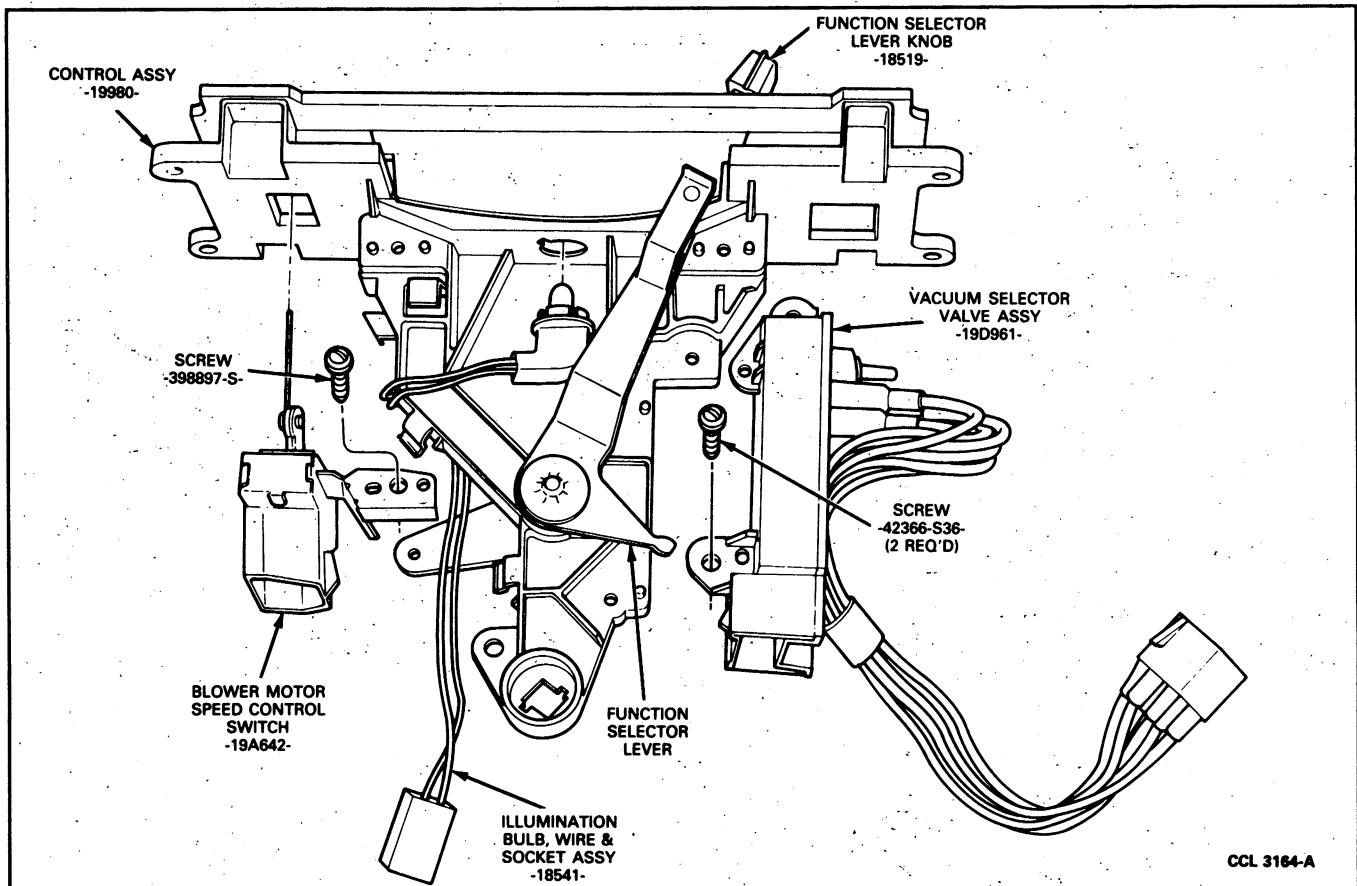


FIG. 27 Manual A/C-Heater Control Assembly

7. To install replacement louvers, drill a 3/16 inch diameter hole through the mounting studs from which staking was removed.
8. Seat the register tabs with barrel clips onto the studs at points B. Align the two inboard tabs with the new holes drilled in the bosses (Points A). Secure the assemblies with a No. 8-12x1/2 inch Type P Washer Head Screw (Part No. 385754) at two places (Points A) each louver, if both are being serviced.
9. Install the upper and two lower finish panels.

### Outside/Recirc Air Door, Vacuum Motor or Door Crank

#### Removal

1. Disconnect the blower motor connector and remove the blower motor.
2. If only the vacuum motor is to be removed, disconnect the two screws which attach the motor to the upper surface of the outside door duct.
3. Pry the motor and arm assembly upward at the arm end to free it from its mounting peg. A retaining flange which is an integral part of the crank, peg, and flange component may partially obstruct the motor arm in its upward movement along the peg. If this retaining flange should break off when forcing the motor arm upward, a 3/16 inch spring nut (Part No. 383358-S) must be used to retain the motor arm when the same or replacement motor is installed. Fig. 39 illustrates removal in View A and

the area in which retainer flange breakage might occur in View B.

4. Look through blower motor opening in the case and use a screwdriver to depress the snap-on door crank while pulling up on door shaft to release the crank from the door (Fig. 40).
5. Remove the door through the blower motor opening.

#### Installation

1. Insert the door through the blower motor opening. Seat the bottom door pivot first, then swing the top door pivot into place.
2. Hold the door in the full outside air position (swing to full in-board position) and snap-in crank (Fig 40).
3. Align the hole in the vacuum motor arm with peg in the door crank.
4. Slide the arm downward over the peg and along the inner surface of the retaining flange with the arm seats the base of the flange surface.

NOTE: If the flange has been broken off install the spring nut as described in Step 2 of the Removal procedure.

5. Install blower motor in the housing and connect the blower motor electrical harness.

### Plenum Doors

#### Removal and Installation

The damper doors inside the plenum assembly cannot be replaced. As a result, if there is a damaged FLOOR/



DEFROST, or PANEL/DEFROST door, the plenum, including these doors, must be replaced. The plenum must also be replaced if there is damage to the case mounting studs which cannot be repaired.

### Plenum Door Vacuum Motors

#### Removal and Installation

The vacuum motors for the PANEL/DEFROST and FLOOR/DEFROST damper doors are attached to the underside of the plenum assembly. Fig. 41 illustrates these motors disassembled from the plenum.

#### Panel/Defrost Door Motor

##### Removal

1. Remove the vacuum hose from the vacuum motor.
2. Remove the two screws which attach the motor and bracket assembly to the plenum.
3. Rotate the assembly so that the slot in the bracket is parallel with the tee-shaped end of the door crank arm. Pull the motor and bracket assembly off the crank arm.

##### Installation

1. Insert the end of the crank arm into the slot in the motor and bracket assembly. Rotate the assembly into alignment with the bracket attaching holes in the plenum.
2. Install the two motor and bracket assembly attaching screws.
3. Install the vacuum hose on the motor.
4. Verify that the system functions properly.

#### Floor/Defrost Door Motor

##### Removal

1. Remove the floor duct as described.
2. Disconnect the two vacuum hoses from the vacuum motor.
3. Remove the two screws which secure the motor and bracket assembly to the plenum.
4. Using a small screwdriver, depress the tang on the side of the door operating lever and pull the motor arm out of the lever (Fig. 41).

##### Installation

1. Slide the motor arm into the door lever until the locking tang engages.
2. Attach the two vacuum hoses.
3. Install the two motor and bracket attaching screws.
4. Install the floor duct.
5. Verify that the system functions properly.

#### Evaporator Case

##### Removal

1. Discharge refrigerant system following the recommended service procedures. Refer to Section 36-30. Observe all safety precautions.
2. Disconnect vacuum supply hose at dash panel. Position check valve away from evaporator case.
3. Disconnect liquid line from evaporator core using a spring lock coupling removal tool (Fig. 42).

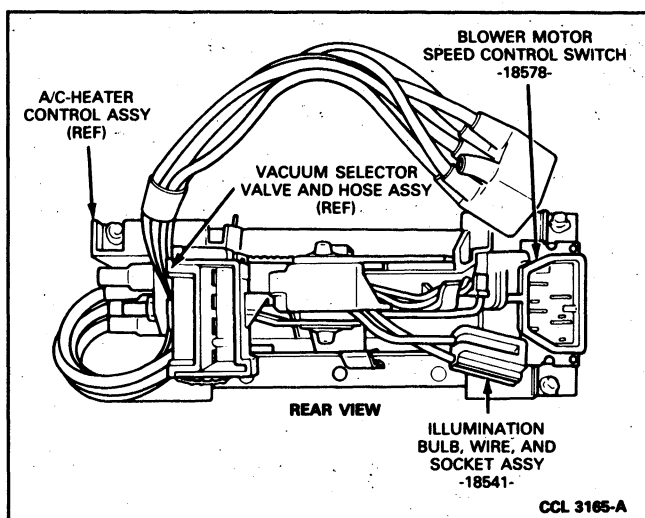


FIG. 28 Blower Speed Switch

4. Disconnect suction line from accumulator. Cap all open refrigerant lines to prevent entrance of dirt and moisture.
5. Disconnect heater hoses from heater core and plug hoses with suitable 15.87mm (5/8 inch) plugs.
6. Working in passenger compartment, remove two screws or nuts attaching bottom of evaporator case to dash panel (Fig. 43). One screw also attaches lower edge of plenum to dash panel.
7. Unplug vacuum harness and two wiring connectors to wiring assembly (14401) located near RH end of plenum harness coming from recirc duct opening back into opening.
8. Remove two screws attaching RH side of recirc duct to dash panel.
9. Remove two retaining nuts attaching evaporator case and recirc duct to dash panel.
10. Pull evaporator case and recirc duct forward and remove it from vehicle.

##### Installation

1. Position recirc duct and evaporator case to dash panel. Install two retaining nuts along top edge of assembly.
2. Install two screws along RH side of recirc duct (Fig. 34).
3. Working in passenger compartment, install top screws to attach bottom of evaporator case to dash panel.
4. Connect vacuum harness from recirc duct opening to the dash panel.
5. Using a new O-ring lubricated with clean refrigerant oil, connect liquid line to evaporator core. Tighten connection to 21-27 N·m (15-20 ft-lb) using two wrenches.
6. Using a new O-ring lubricated with clean refrigerant oil, connect suction line to accumulator. Tighten connection to 34-44 N·m (28-33 ft-lb) using two wrenches.
7. Connect heater hoses to heater core. Tighten clamps only to 1.4-2.0 N·m (12-18 in-lb).

8. Connect vacuum harness and two wiring connectors to wiring assembly (14401) under instrument panel.
  9. Fill and bleed cooling system. Refer to Section 27-02.
  10. Leak test, evacuate and charge system following recommended procedures. Observe all safety precautions.
  11. Check system for proper operation.
  12. Refer to Section 36-30 for Evaporator Leak Test.
7. Remove spring clip holding MAP sensor to housing (on all gas engines). Put MAP sensor aside.
  8. Remove one nut retaining upper LH corner of evaporator case to dash panel.
  9. Remove six screws attaching LH evaporator cover to evaporator case.
  10. Remove LH evaporator cover from evaporator case.
  11. Remove evaporator core and suction accumulator from evaporator case (Fig. 44).

## Evaporator Core

### Removal

1. Discharge refrigerant system following recommended service procedures. Observe all safety precautions.
2. Disconnect electrical connector from pressure switch on side of suction accumulator.
3. Remove pressure switch from accumulator.
4. Disconnect suction hose from suction accumulator. Use a backup wrench to loosen fitting. Cap suction hose to prevent entry of dirt and excess moisture.
5. Using a spring lock coupling tool, disconnect liquid line from evaporator core. Cap liquid line to prevent entry of dirt and excess moisture.
6. Remove one nut retaining MAP sensor bracket to the upper LH corner of evaporator case.

### Installation

1. Transfer suction accumulator support straps and spring nuts to the replacement evaporator core.
2. Install evaporator core into evaporator case.
3. Position evaporator cover to evaporator case. Install six screws to attach cover to evaporator case along flange.
4. Install one nut to retain upper LH Corner of case to dash panel.
5. Install one spring clip to rib on evaporator case and push into position.
6. Install one nut to retain upper LH corner of MAP sensor bracket to the upper LH corner of evaporator case.
7. In passenger compartment, install one screw to attach lower edge of the plenum and bottom of the evaporator case to dash panel.

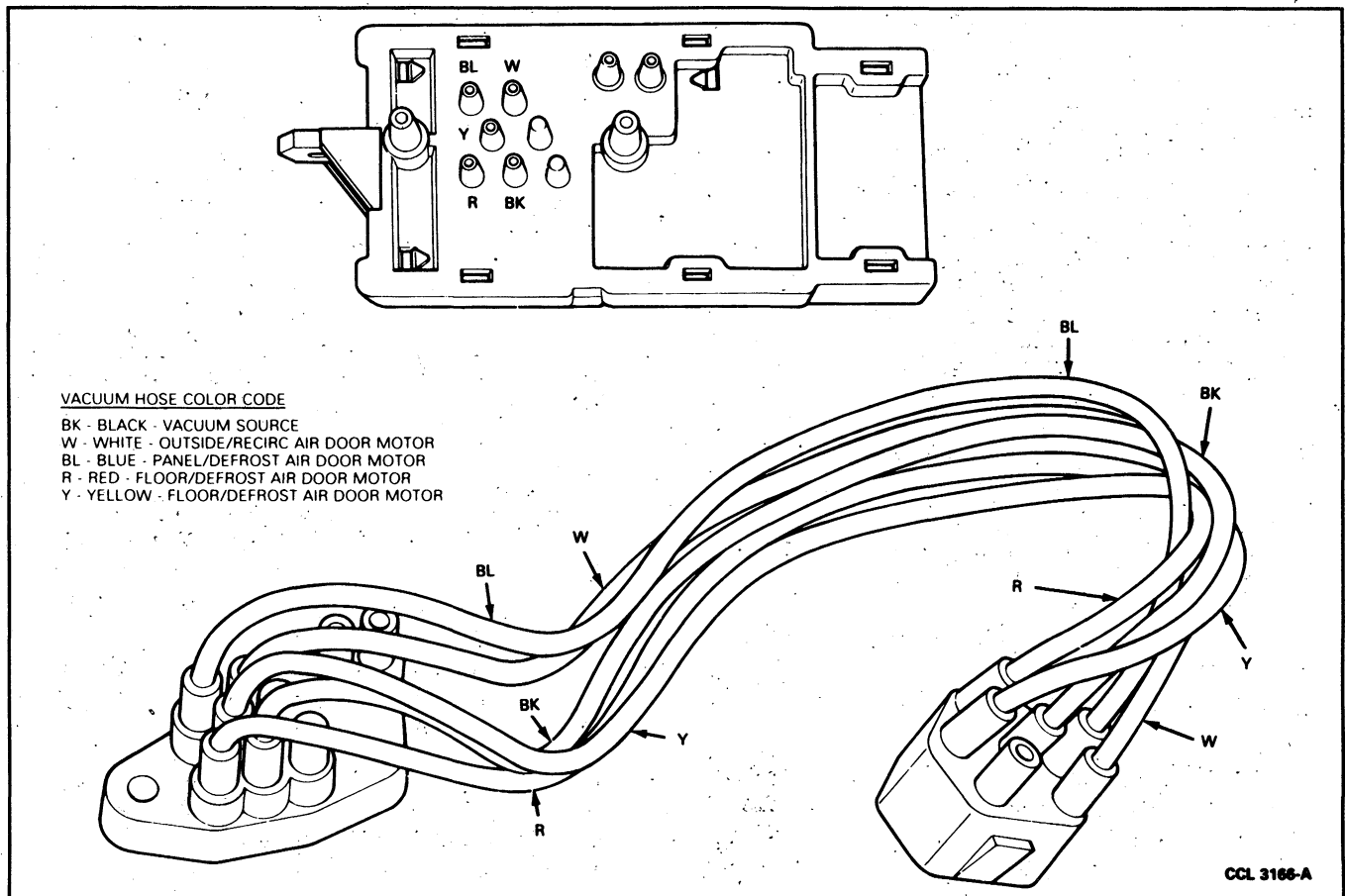
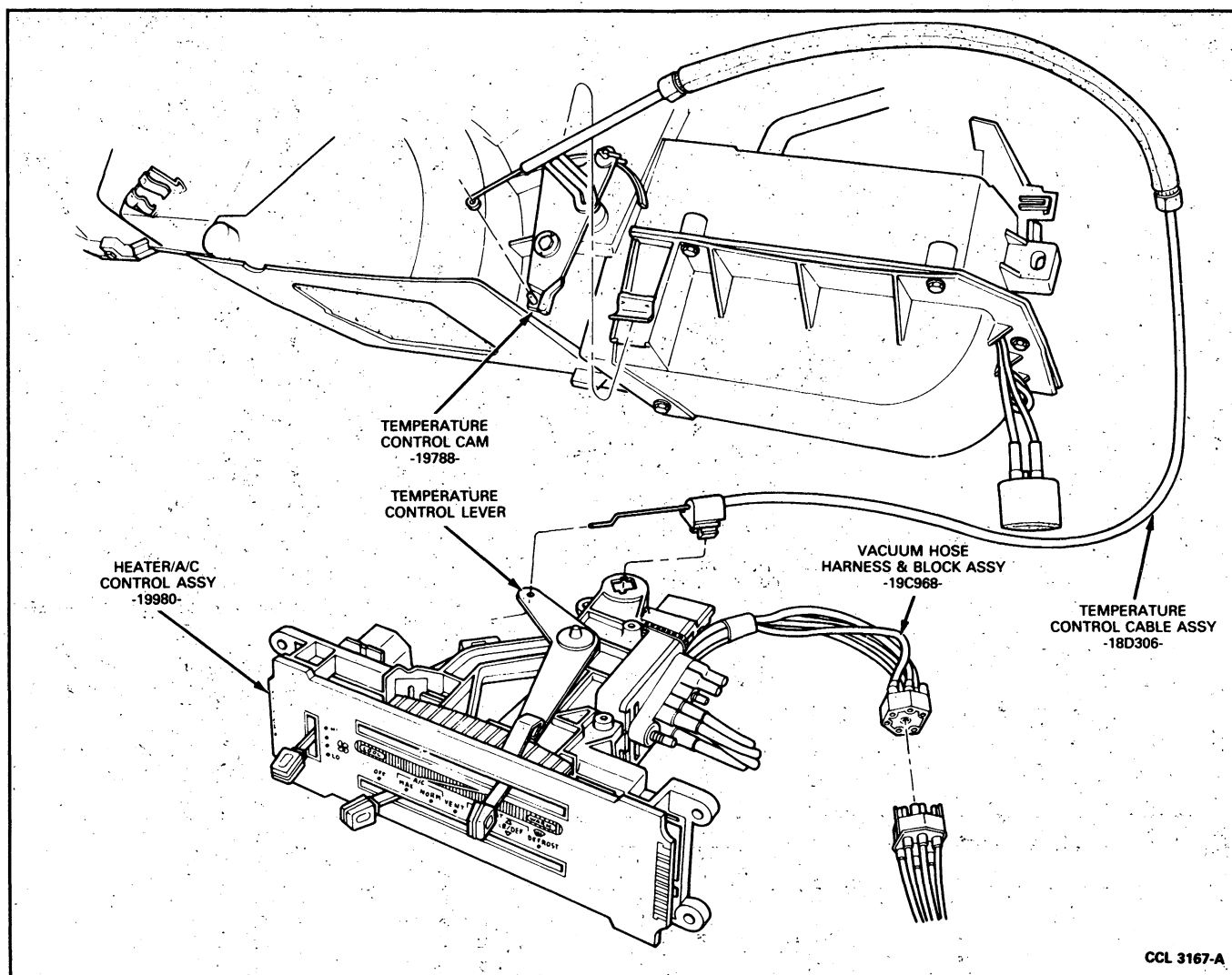


FIG. 29 Vacuum Selector Valve



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**FIG. 30 Temperature Control Cable Removal**

8. Remove cap from evaporator core liquid line connection and install a new fixed orifice tube in the evaporator core tube as outlined.
9. Using new O-ring lubricated with clean refrigerant oil, connect liquid line to evaporator core. Push spring lock coupling until it snaps secure. Pull back to make sure connection is completed.
10. Add 88.7ml (3 ounces) of clean refrigerant oil to a new suction accumulator to compensate for oil lost in evaporator core replacement.
11. Using a new O-ring lubricated with clean refrigerant oil, connect suction accumulator to evaporator core.
12. Install suction accumulator support straps (two screws). Tighten accumulator-to-evaporator core fitting to 21-27 N·m (15-20 ft-lb). Use a backup wrench on accumulator to prevent component damage.
13. Using a new O-ring lubricated with clean refrigerant oil, connect suction hose to suction accumulator. Use a backup wrench to prevent component damage.
14. Using a new O-ring lubricated with clean refrigerant oil, install pressure switch on suction accumulator nipple.
15. Connect electrical connector to pressure switch.
16. Leak test, evacuate and charge system following recommended procedures. Observe all safety precautions.
17. Check system for proper operation.

### Blower Motor Resistor

#### Removal and Installation

1. Disconnect wire connector from resistor assembly (Fig. 7).
2. Remove two screws attaching resistor assembly to evaporator case and remove resistor.
3. To install, apply a bead of sealer D6AZ-19560-A or equivalent around the resistor mounting board.
4. Position resistor in opening in evaporator case, and install two attaching screws.
5. Connect wire connector to resistor assembly.
6. Check blower motor for proper operation in all blower speeds.

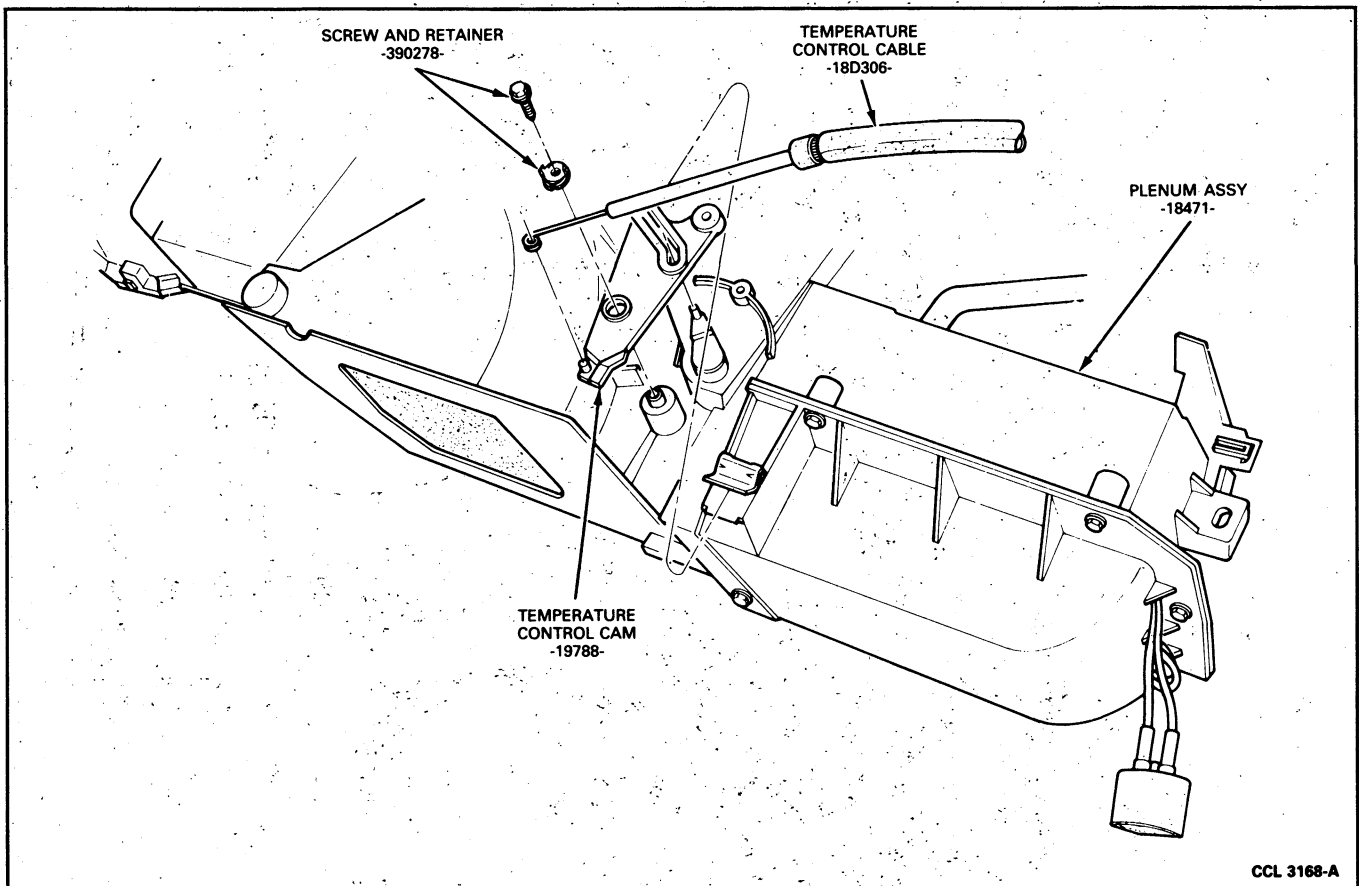


FIG. 31 Temperature Control Cam

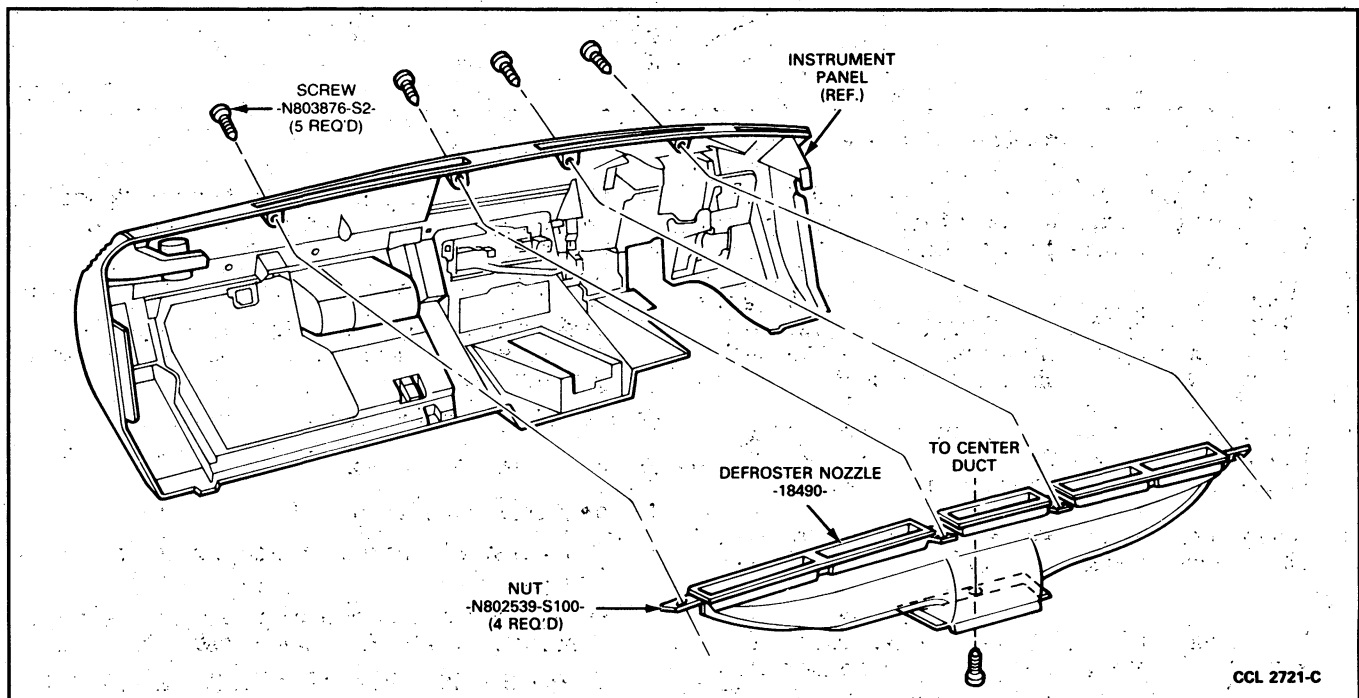


FIG. 32 Defroster Nozzle

**Blower Motor and/or Wheel****Removal**

1. Disconnect motor connector.
2. Disconnect blower motor air cooling tube from motor.

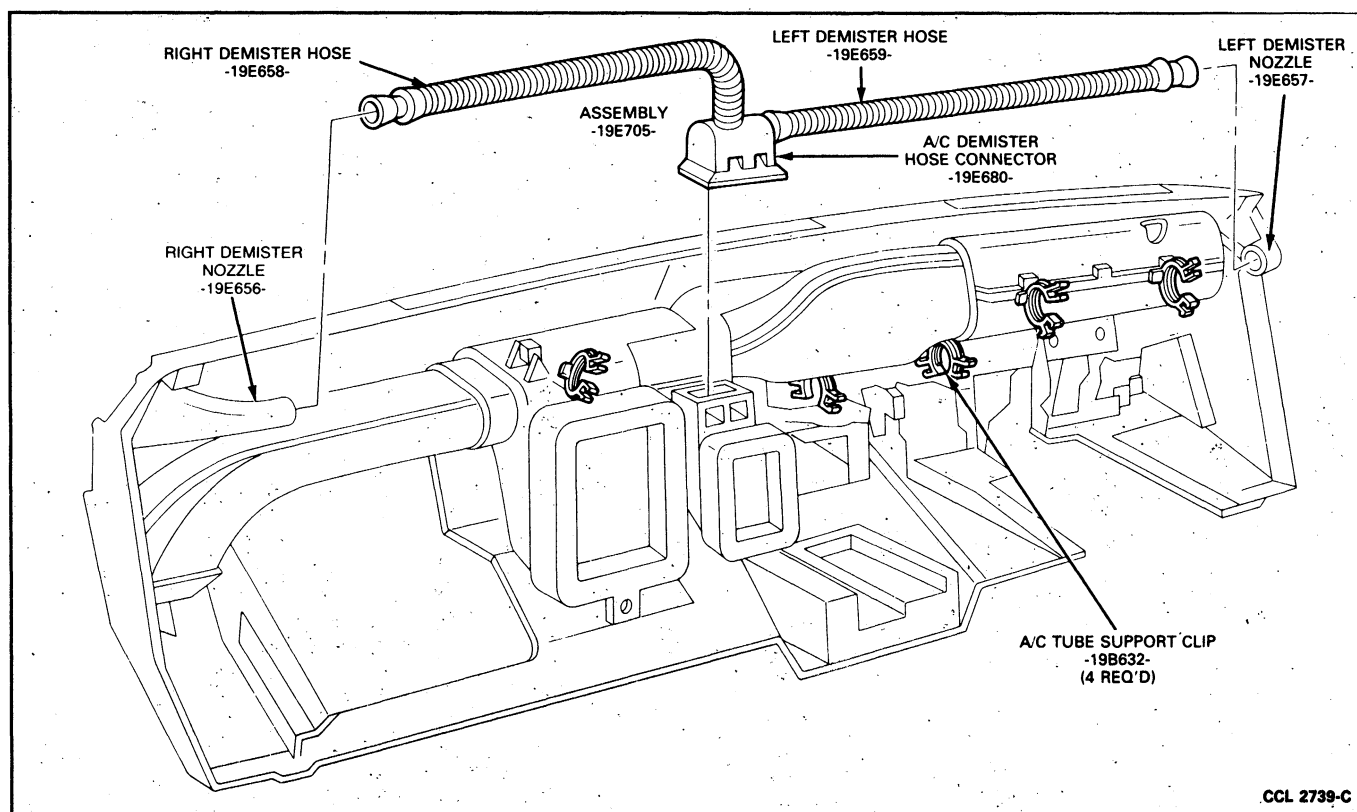


FIG. 33 Demister Nozzle and Hoses

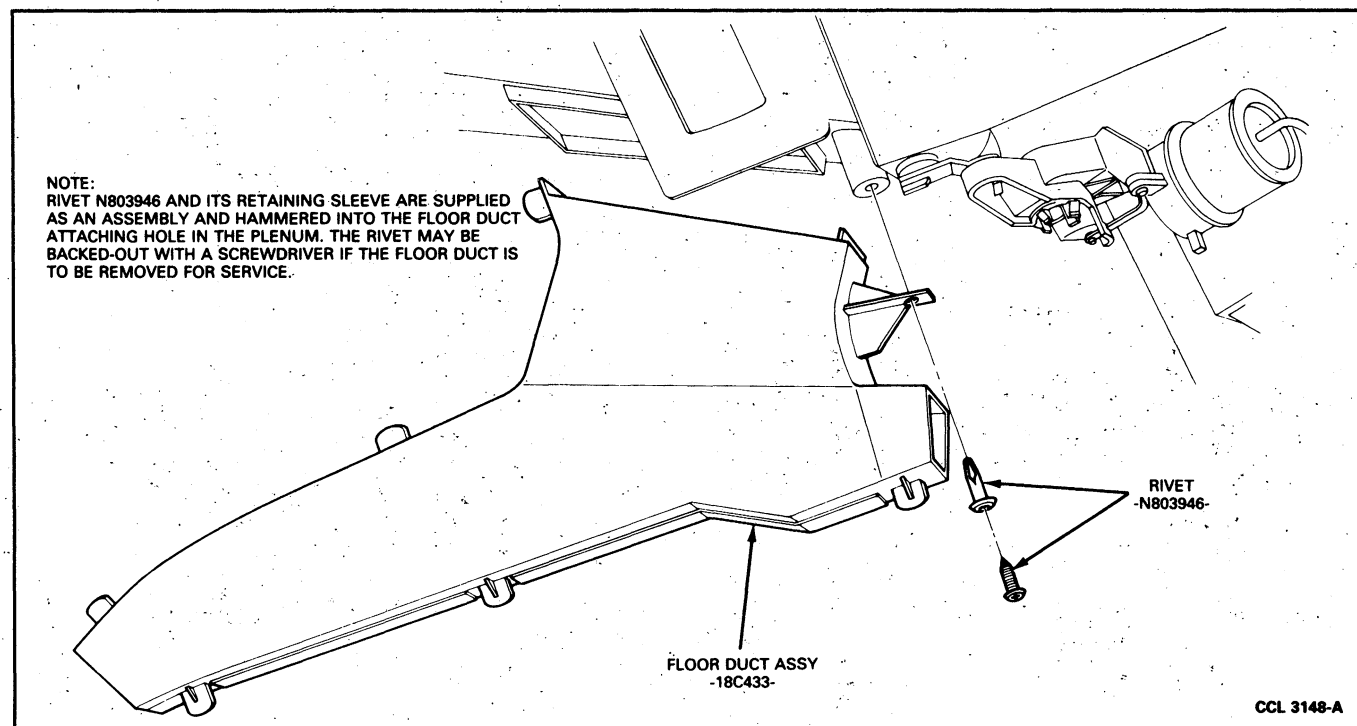


FIG. 34 Floor Duct

3. Remove four blower motor mounting plate attaching screws and remove motor and wheel assembly from blower housing.
4. Remove hub clamp spring from blower wheel hub and remove blower wheel from motor shaft.

#### Installation

1. Position blower wheel on blower motor shaft. Then, install a new hub clamp spring on blower hub. NOTE: The hub clamp spring (Part No. 384260-S32) is included with a new blower wheel, but not with blower motor.

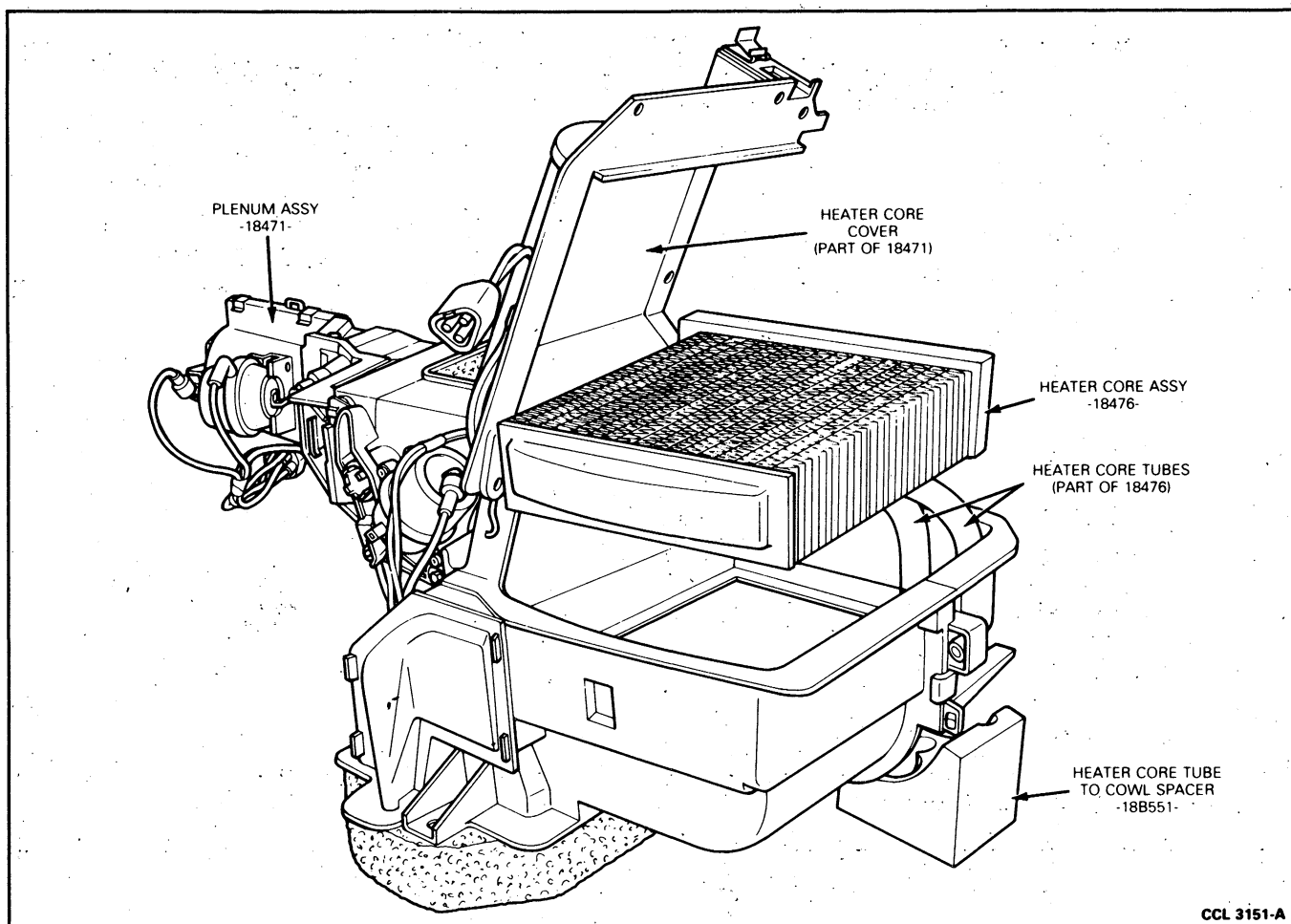


FIG. 35 Heater Core Access Cover and Core Removal

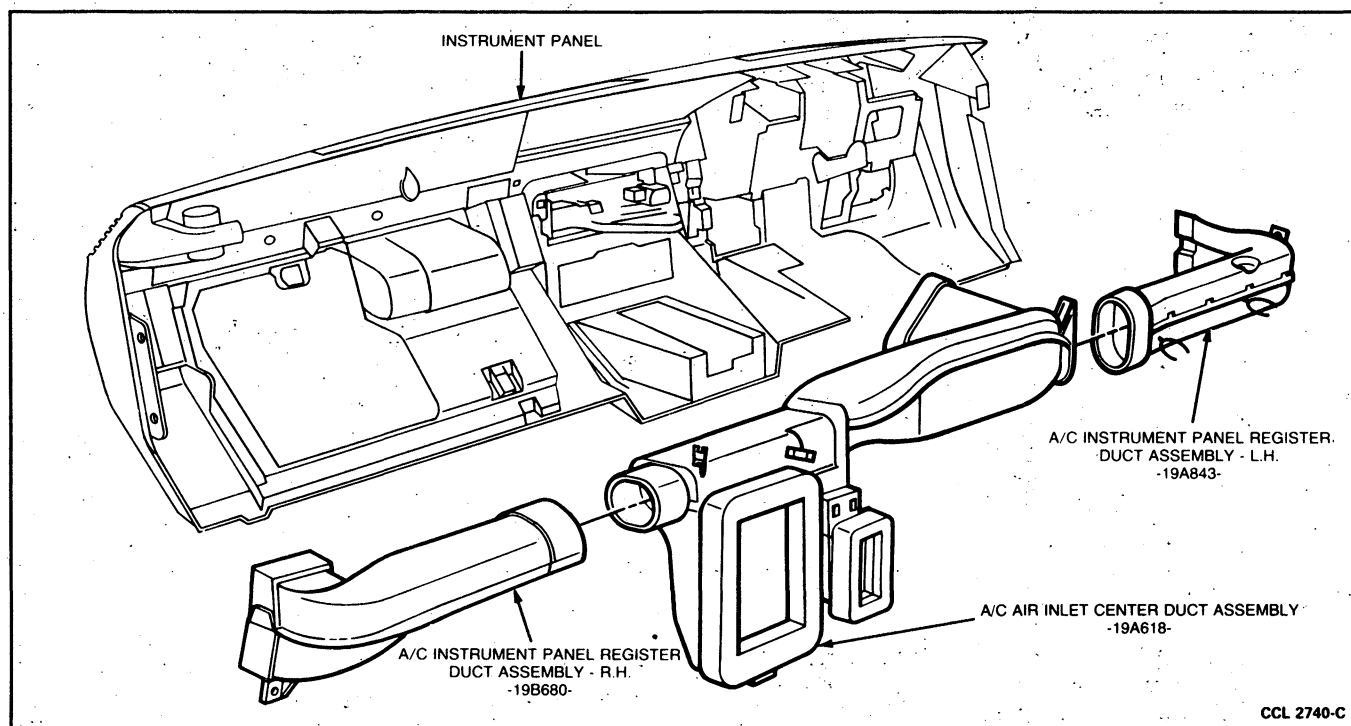
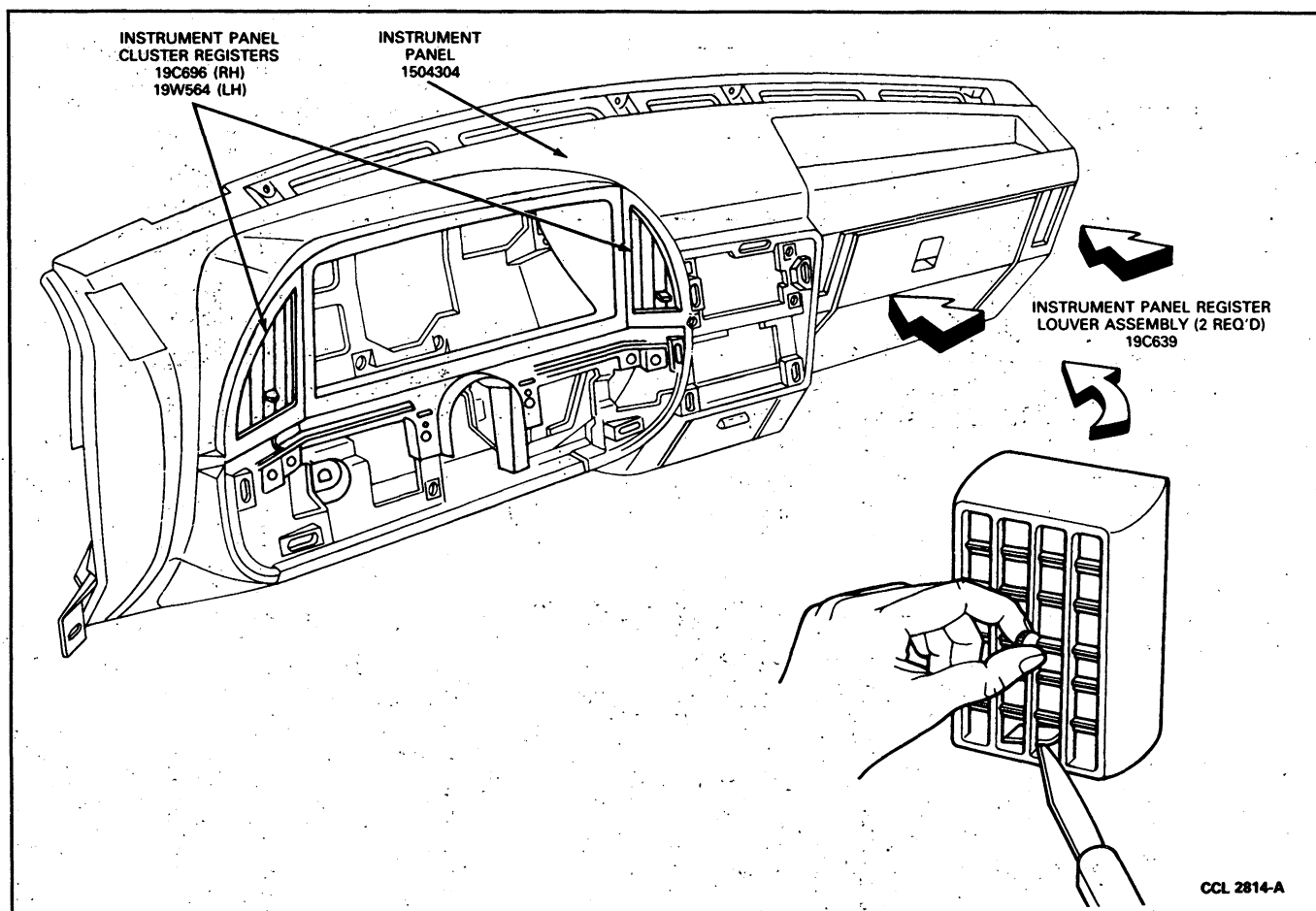


FIG. 36 Register Ducts



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FIG. 37 Instrument Panel Register Louver Removal—Passenger Side

2. Install a new motor mounting seal on blower motor flange.
3. Position blower motor and wheel assembly in blower housing and install four attaching screws.
4. Cement blower motor air tube on nipple of blower housing with Liquid Butyl Sealer C9AZ-19554-B or equivalent.
5. Connect blower motor connector.
6. Check blower motor for proper operation.
2. Disconnect liquid line from evaporator core using specified spring lock coupling tool. Cap liquid line to prevent entrance of dirt and excessive moisture.
3. Pour a small amount of clean refrigerant oil into evaporator core inlet tube to lubricate tube and orifice O-rings during removal of fixed orifice tube from evaporator core tube.
4. Engage the Orifice Tube Remover and Installer T83L-19990-A (Motorcraft YT-1008) or equivalent with the two tangs on the fixed orifice tube (Fig. 35).

#### Fixed Orifice Tube

The fixed orifice tube is constructed with a plastic body, two screens, and a small brass tube down the center of the orifice body (Fig. 45). Two O-rings are around the orifice tube body to seal against leakage.

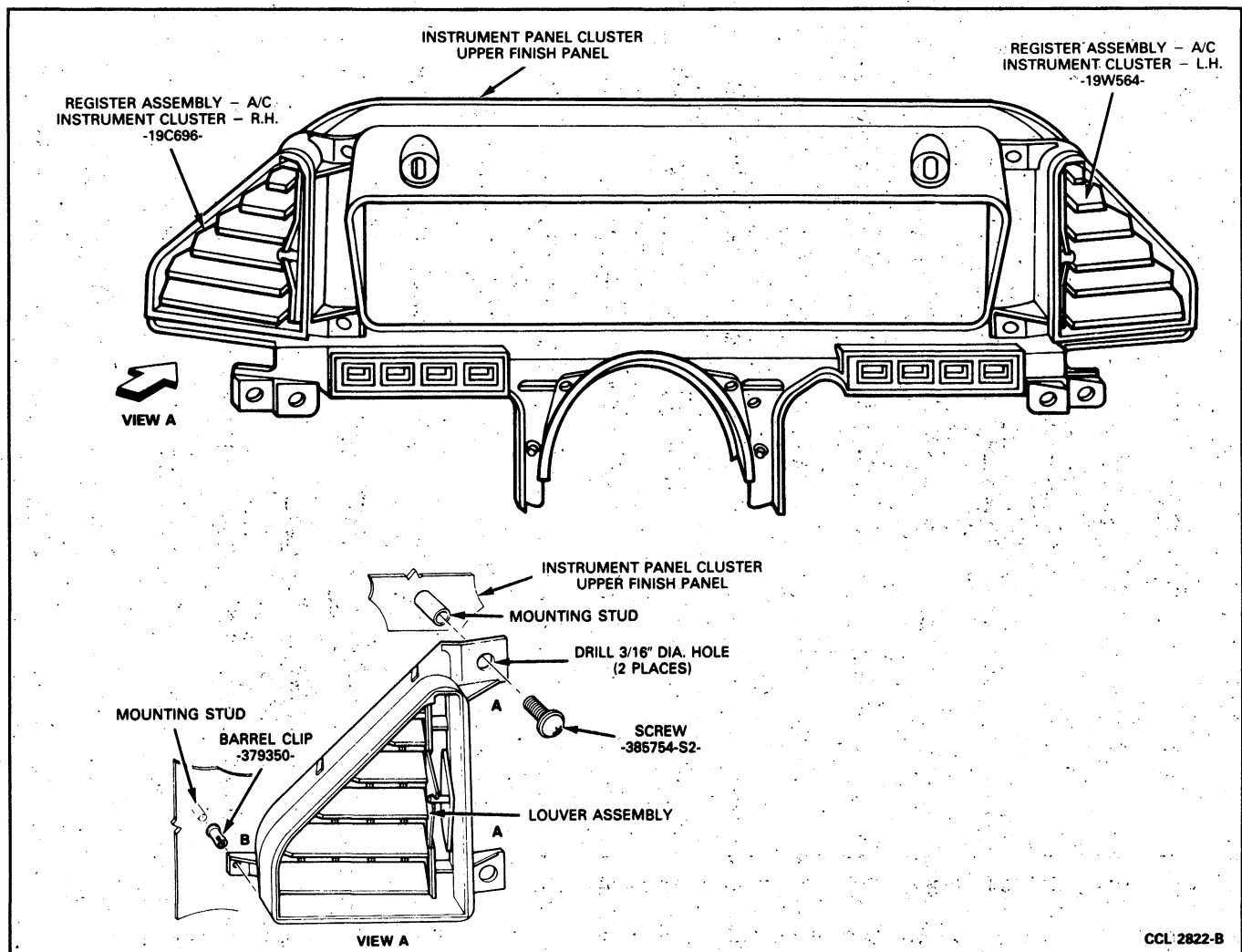
**CAUTION: DO NOT attempt to remove the fixed orifice tube with pliers or to twist or rotate the orifice tube in the evaporator core tube. To do so will break the fixed orifice tube body in the evaporator core tube. USE ONLY the recommended tool following the recommended service procedures.**

#### Removal

1. Discharge refrigerant from A/C system following recommended service procedures. Observe all safety precautions.

**CAUTION: Do not twist or rotate the fixed orifice tube in the evaporator core tube as it may break off in the evaporator core tube.**

5. Hold T-handle of Orifice Tube Remover and Installer T83L-19990-A (Motorcraft YT-1008) or equivalent to keep it from turning, and run nut on tool down against evaporator core tube until orifice is pulled from tube.
6. If fixed orifice tube breaks in evaporator core tube, it must be removed from tube with Broken Orifice Tube Extractor T83L-19990-B (Motorcraft YT-1009) or equivalent.
7. To remove a broken orifice tube, insert screw end of Broken Orifice Tube Extractor T83L-19990-B (Motorcraft YT-1009) or equivalent into evaporator core tube. Thread screw end of tool into brass tube in center of fixed orifice tube. Pull fixed orifice tube from evaporator core tube.



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FIG. 38 Removal of Registers from Instrument Cluster Upper Finish Panel

8. If only brass center tube is removed during Step 7, insert screw end of the Broken Orifice Tube Extractor T83L-19990-B (Motorcraft YT-1009) or equivalent into evaporator core tube and screw end of tool into fixed orifice tube body. Pull fixed orifice tube body from evaporator core tube.

#### Installation

1. Lubricate O-rings on fixed orifice tube body liberally with clean refrigerant oil.
2. Place fixed orifice tube in Orifice Tube Remover and Installer T83L-19990-A (Motorcraft YT-1008) or equivalent, and insert fixed orifice tube into evaporator core tube until orifice is seated at stop.
3. Remove Orifice Tube Remover and Installer T83L-19990-A or equivalent from fixed orifice tube.
4. Using a new O-ring lubricated with clean refrigerant oil, connect liquid line to evaporator core tube. Push spring lock coupling until it snaps securely in place. Pull back to make sure connection is completed.
5. Leak test, evacuate and charge system following recommended service procedures. Observe all safety precautions.
6. Check system for proper operation.

#### Suction Accumulator/Drier

##### Removal

1. Discharge refrigerant from A/C system following recommended service procedures. Observe all safety precautions.
2. Disconnect electrical connector from pressure switch (Fig. 46).
3. Remove pressure switch by unscrewing it from suction accumulator (Fig. 46).
4. Disconnect suction hose from suction accumulator/drier. Use two wrenches to prevent component damage. Cap suction hose to prevent entrance of dirt and moisture.
5. Loosen fitting connecting suction accumulator/drier to evaporator core. Use two wrenches to prevent component damage.
6. Remove two screws attaching suction accumulator/drier strap to evaporator case and clip to evaporator core inlet tube.

##### Installation

1. Using a new O-ring lubricated with clean refrigerant oil, connect suction accumulator/drier to



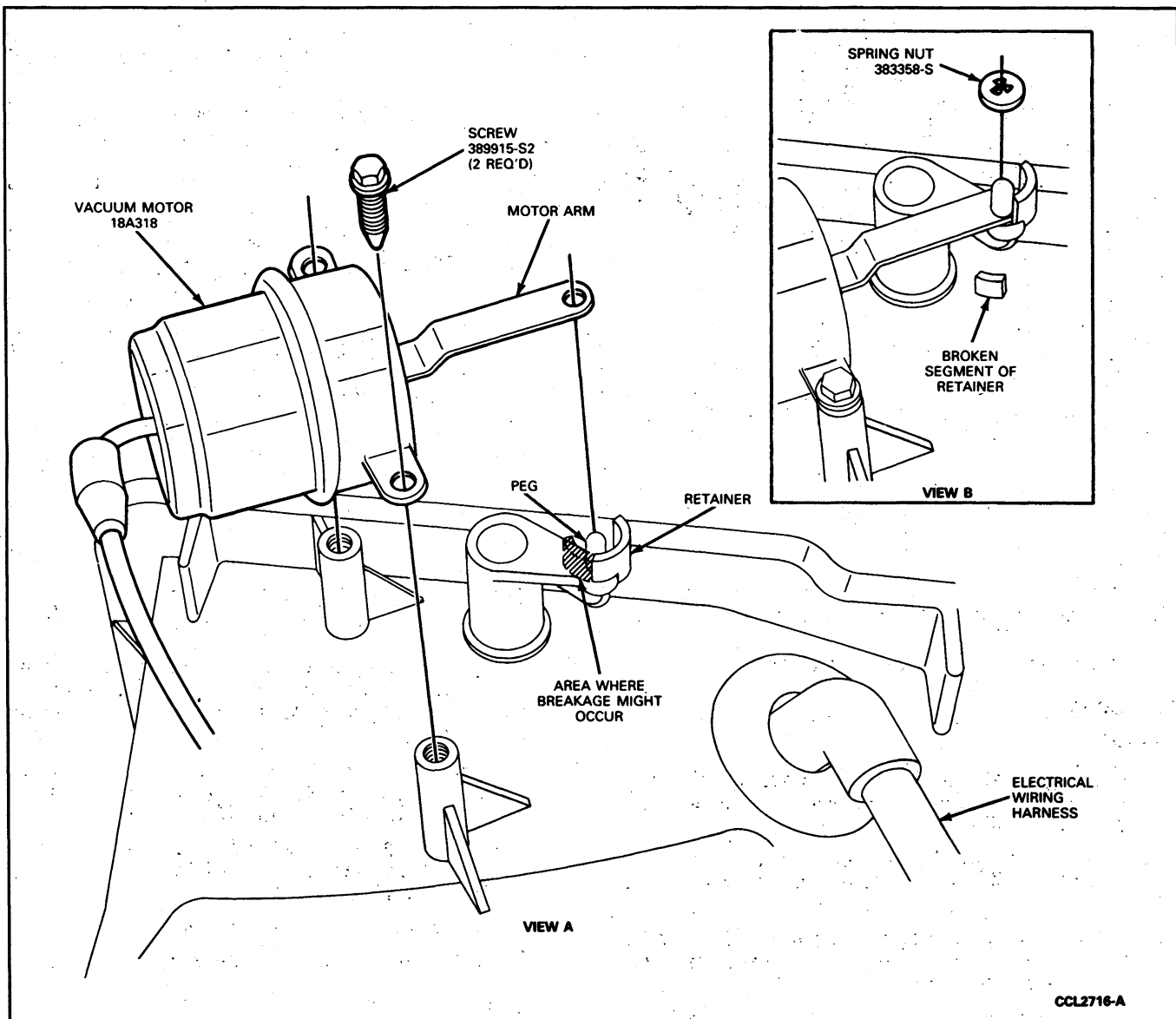


FIG. 39 Outside/Recirc Air Door Removal

1. Tighten connection finger-tight.
2. Position strap on suction accumulator/drier to evaporator case and clip to evaporator core inlet tube. Align strap and clip with mounting bracket and install two attaching screws. Loosen connection of accumulator/drier to evaporator core if it is necessary to re-position accumulator/drier to install strap attaching screws.
3. Tighten suction accumulator/drier-to-evaporator core fitting to specification using two wrenches.
4. Using a new O-ring lubricated with clean refrigerant oil, connect suction hose to accumulator/drier. Use two wrenches and tighten connection to specification.
5. Install a new O-ring lubricated with clean refrigerant oil on pressure switch nipple of suction accumulator/drier. Install pressure switch. Tighten switch to 7-13 N·m (5-10 ft-lb) if switch has metal base and hand tighten only if switch has plastic base.

6. Connect electrical connector to pressure switch.
7. Leak test, evacuate and charge system following the recommended service procedures. Observe all safety precautions.
8. Check system for proper operation.

### Clutch Cycling Pressure Switch

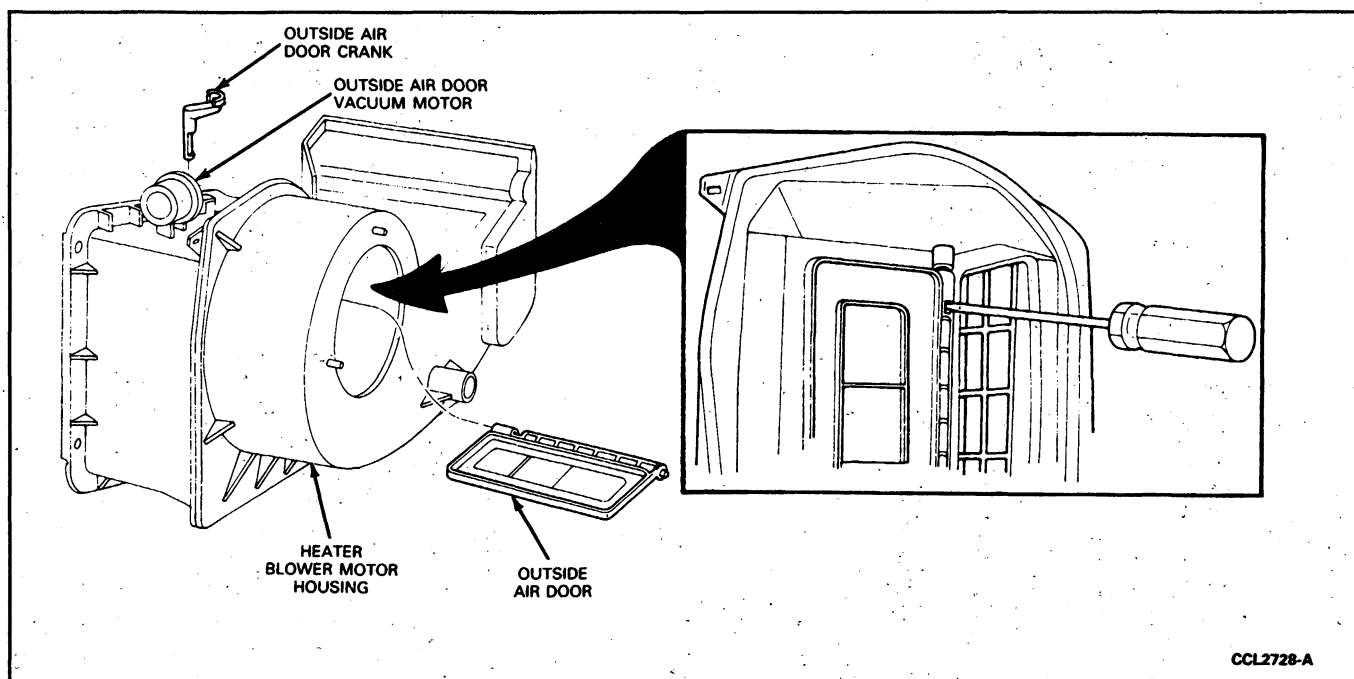
#### Removal

1. Disconnect wire connector from pressure switch.
2. Unscrew pressure switch from suction accumulator (Fig. 47).

NOTE: Do not vent refrigerant charge.

#### Installation

1. Install a new O-ring lubricated with clean refrigerant oil on accumulator nipple (Fig. 47).
2. Screw pressure switch on accumulator nipple hand tight only.
3. Connect wire connector to pressure switch.



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FIG. 40 Removing Outside Air Door Crank

4. Check system for proper operation.

## Condenser

### Removal

1. Discharge refrigerant from system following recommended service procedures. Observe all safety precautions.
2. Disconnect liquid line from condenser. Cap liquid line to prevent entrance of dirt and moisture (Fig. 48).
3. Disconnect compressor discharge line from condenser. Cap discharge line to prevent entrance of dirt and moisture.
4. Partially drain radiator and disconnect upper hose from radiator.
5. Working under vehicle, remove two screws attaching two condenser lower mounting brackets to front radiator support (Fig. 48).
6. Remove bolts from radiator upper retaining brackets.
7. Tilt top of radiator rearward and remove two screws attaching two condenser upper mounting brackets to rear side of radiator support.
8. Lift condenser from vehicle.

### Installation

1. Position condenser to vehicle with lower mounting brackets on front side of radiator support and upper brackets on rear side (Fig. 48).
2. Install four screws attaching four mounting brackets to radiator support. Tighten screws to 13.6 N·m (10-14 ft-lb).
3. Move radiator into correct installed position and install bolts to upper retaining brackets.
4. Connect radiator upper hose to radiator and fill cooling system to specified level.

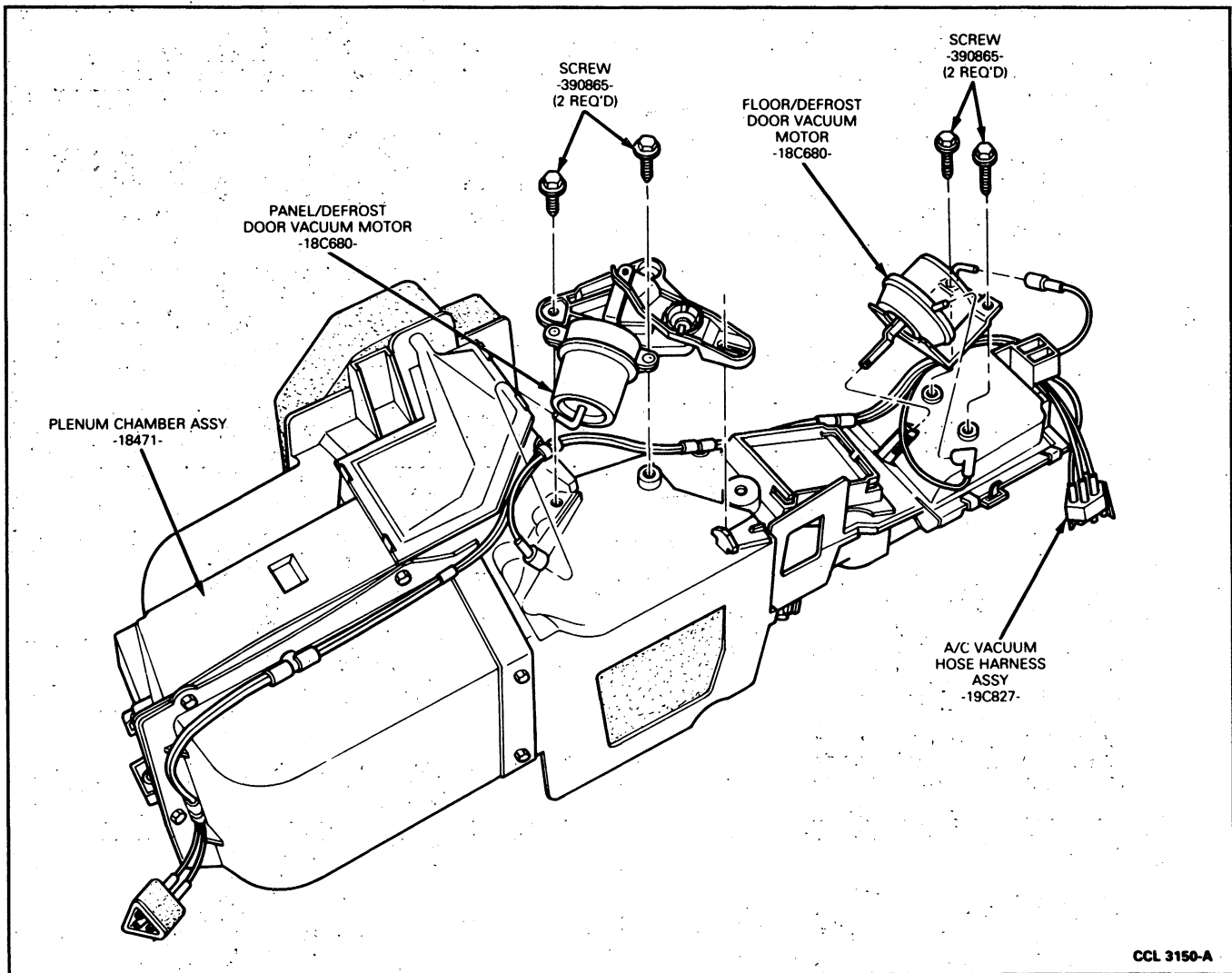
5. Using a new O-ring lubricated with clean refrigerant oil, connect compressor discharge line to condenser. Tighten connection to 21-27 N·m (15-20 ft-lb).
6. Connect liquid line to condenser using a new O-ring lubricated with clean refrigerant oil. Tighten connection to 21-27 N·m (15-20 ft-lb).
7. Leak test, evacuate and charge system following recommended service procedures. Observe all safety precautions.
8. Check system for proper operation.
9. Refer to Section 36-30, Condenser Leak Test.

## Refrigerant Lines

Fig. 49 illustrates a typical refrigerant line installation. In addition to tube and hose routing, the physical state of the refrigerant is shown as it passes through the A/C system.

Figs 50 through 54 illustrate both heater and A/C tube and hose routing for each engine. A typical removal and installation procedure is as follows.

1. Discharge refrigerant from system following recommended procedure. Observe all safety precautions.
2. Disconnect and remove refrigerant line using a wrench on each side of fitting.
3. If spring lock couplings are used, disconnect couplings as shown in Fig. 42. Use Spring Lock Coupling T81P-19623-G, G2 and/or T83P-19623-C or equivalent to disconnect the 12.7mm (1/2-inch) and the 15.87mm (5/8-inch) coupling.
4. Route new refrigerant line (with protective caps installed).
5. Connect refrigerant line into system using new O-rings lubricated with clean refrigerant oil. Tighten connections to 9 N·m (7 ft-lb) (self-sealing coupling) and 21-27 N·m (15-20 ft-lb) (non self-



**FIG. 41 Plenum Door Vacuum Motors**

- sealing coupling), using a backup wrench to prevent component damage.
6. Connect spring lock couplings as shown in Fig. 42. Use only specified O-rings.
7. Leak test, evacuate and charge refrigerant system following recommended procedures and safety precautions. Then, check system for proper operation.

### Heater Hoses

Refer to Section 36-25 for details regarding the servicing of heater hoses on F-150—F-350, F-Super Duty and Bronco vehicles.

1. Drain coolant from cooling system.
2. Loosen clamps and remove heater hose(s) from vehicle.
3. Cut a new length of heater hose to dimension of removed heater hose(s).
4. Route heater hose(s).
5. Connect heater hose to fittings and tighten clamps to 1.8-2.5 N·m (16-22 in-lb). DO NOT over-tighten hose clamps.

6. Fill and bleed cooling system. Refer to Section 27-02.
7. Check for coolant leaks and for proper operation of system.

### Cross References

#### Compressor

Refer to Section 36-30 for compressor removal and installation procedures.

#### Compressor Clutch

Refer to Section 36-37 for compressor clutch removal and installation procedures.

#### Compressor Clutch Field Coil

Refer to Section 36-37 for compressor clutch field coil removal and installation procedures.

### COMPRESSOR

F-Series and Bronco vehicles will be equipped with one of the five engines specified for standard or

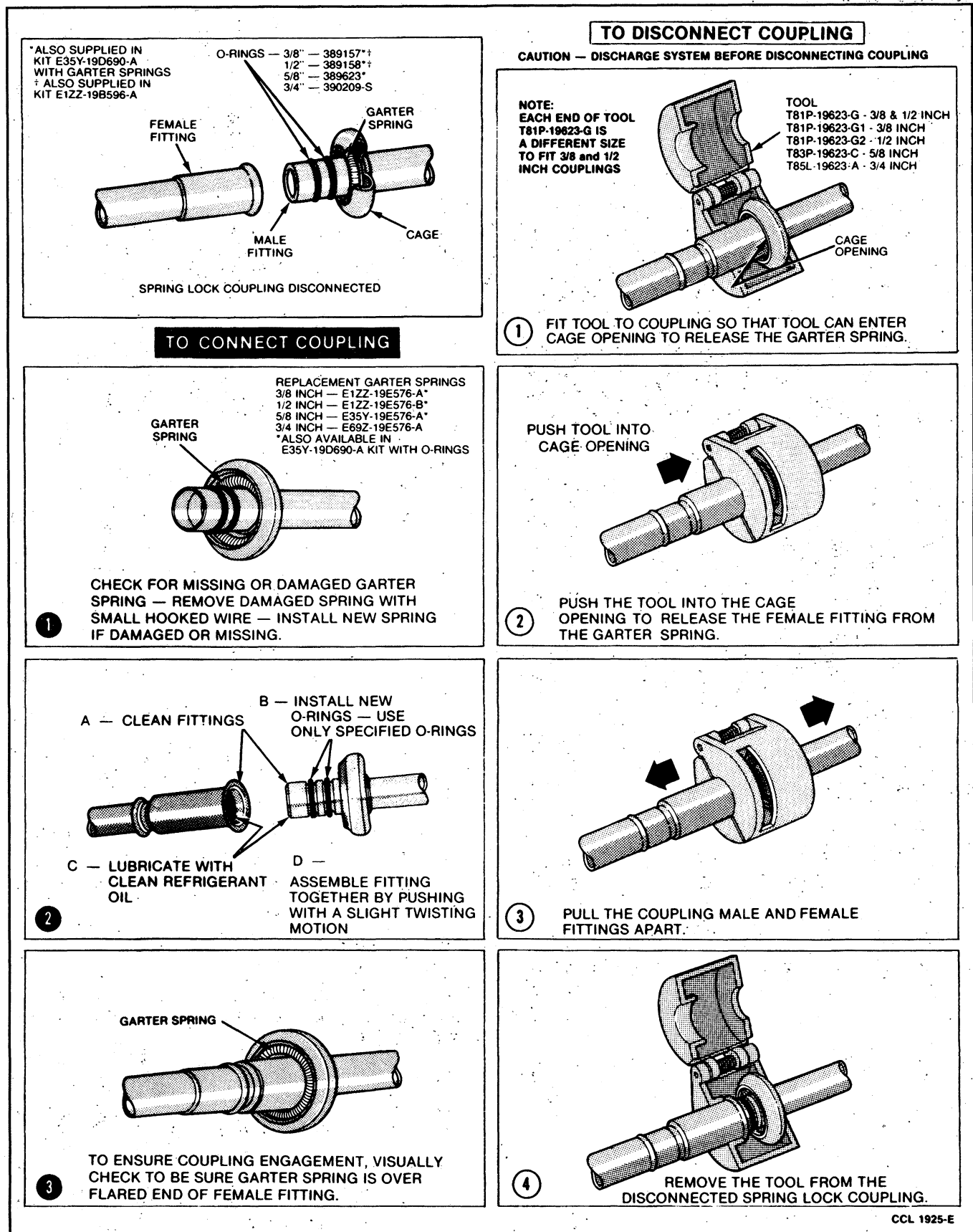
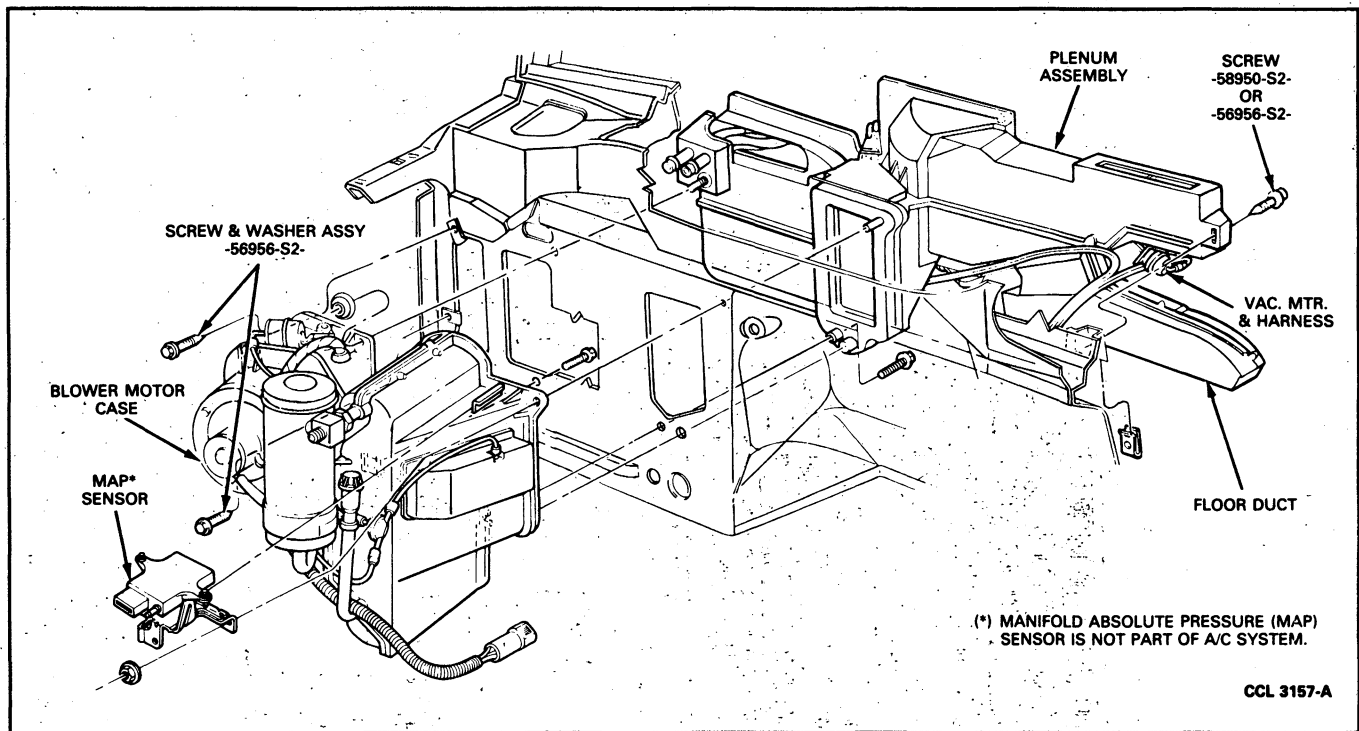


FIG. 42 Spring Lock Coupling Tools



**FIG. 43 Evaporator Case Removal**

optional applications. These engines are identified in the following chart.

Displacement (Liters)	Fuel System
4.9L	EFI
5.0L	EFI
5.8L	EFI
7.3L	Diesel
7.5L	EFI

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Figures 55 through 58 illustrates the compressor installation for each of the engines in the chart.

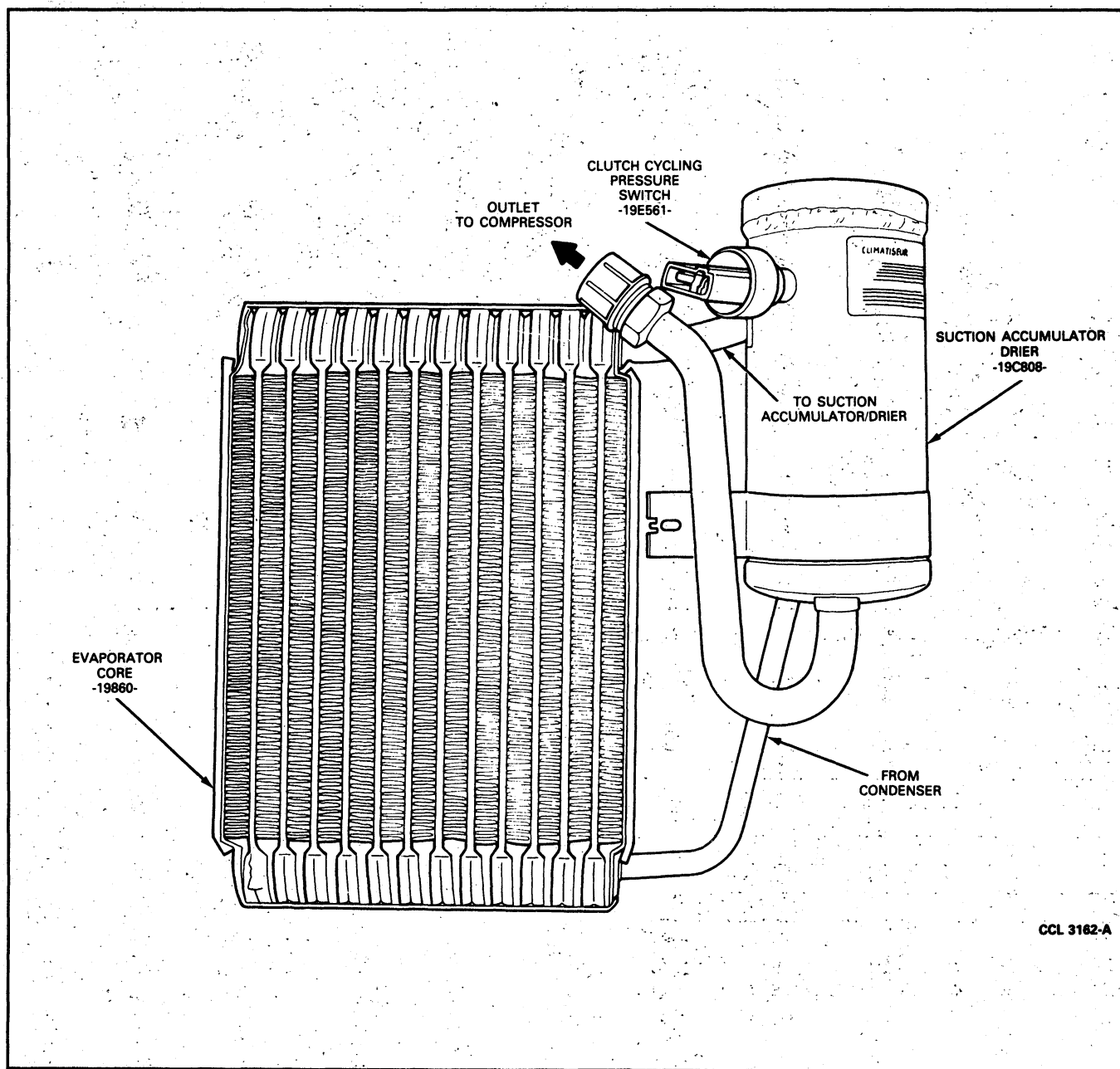
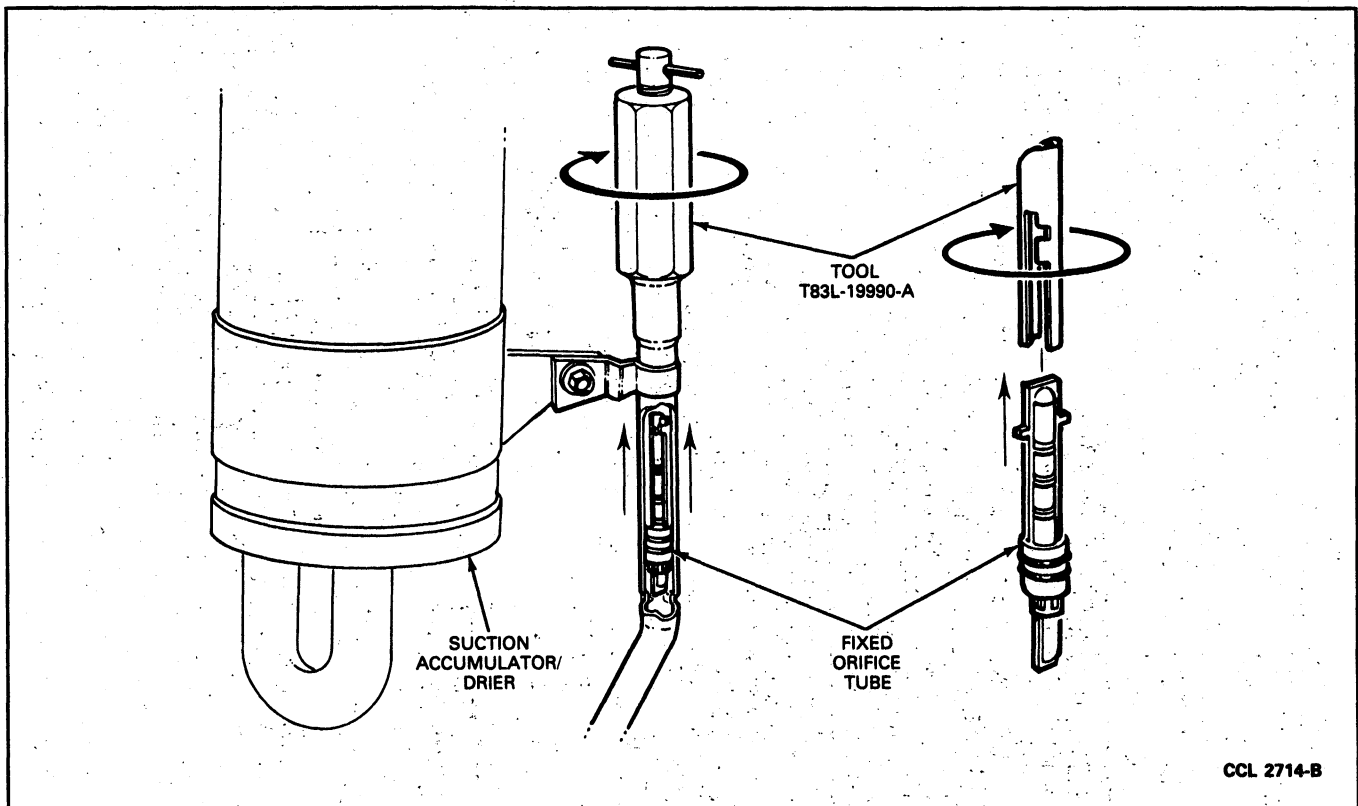
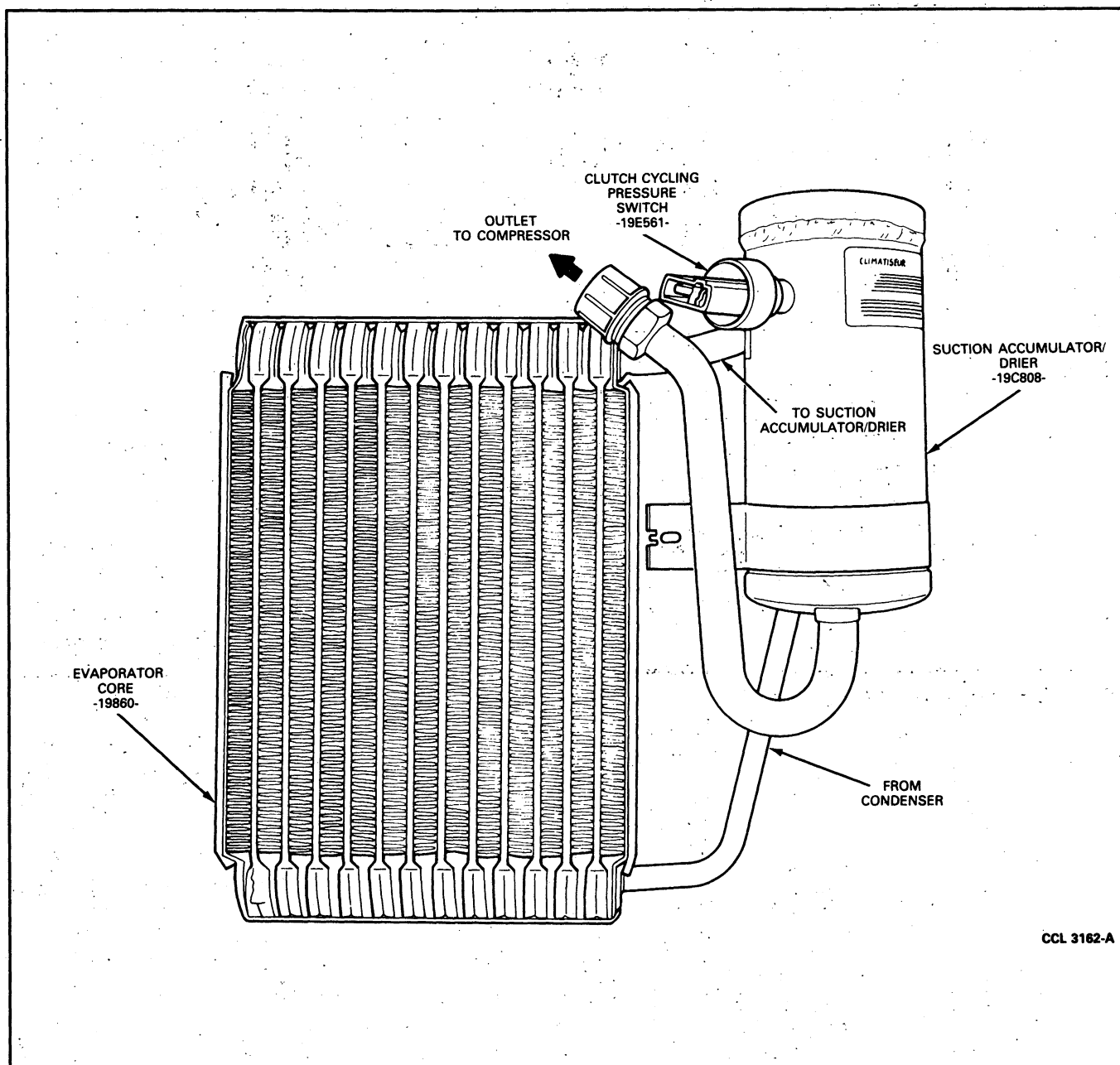


FIG. 44 Evaporator Core and Suction Accumulator/Drier



**FIG. 45 Removal of Fixed Orifice Tube**

**FIG. 46 Suction Accumulator/Drier**



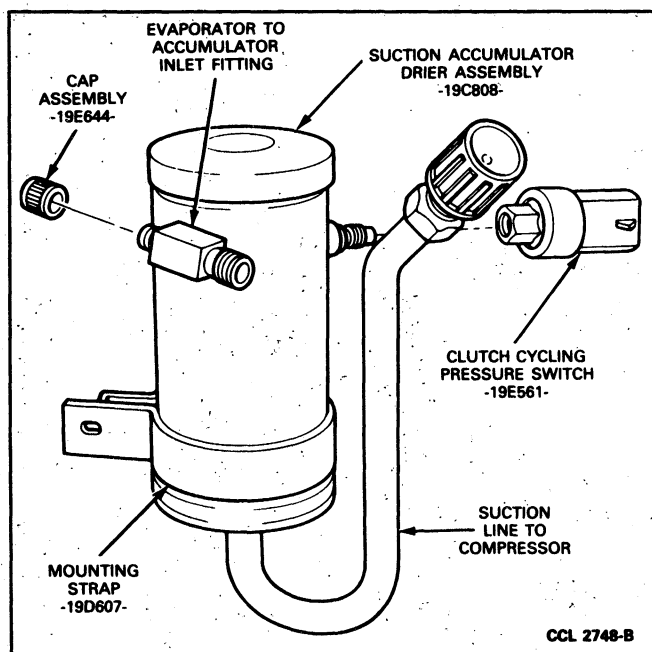


FIG. 47 Clutch Cycling Pressure Switch

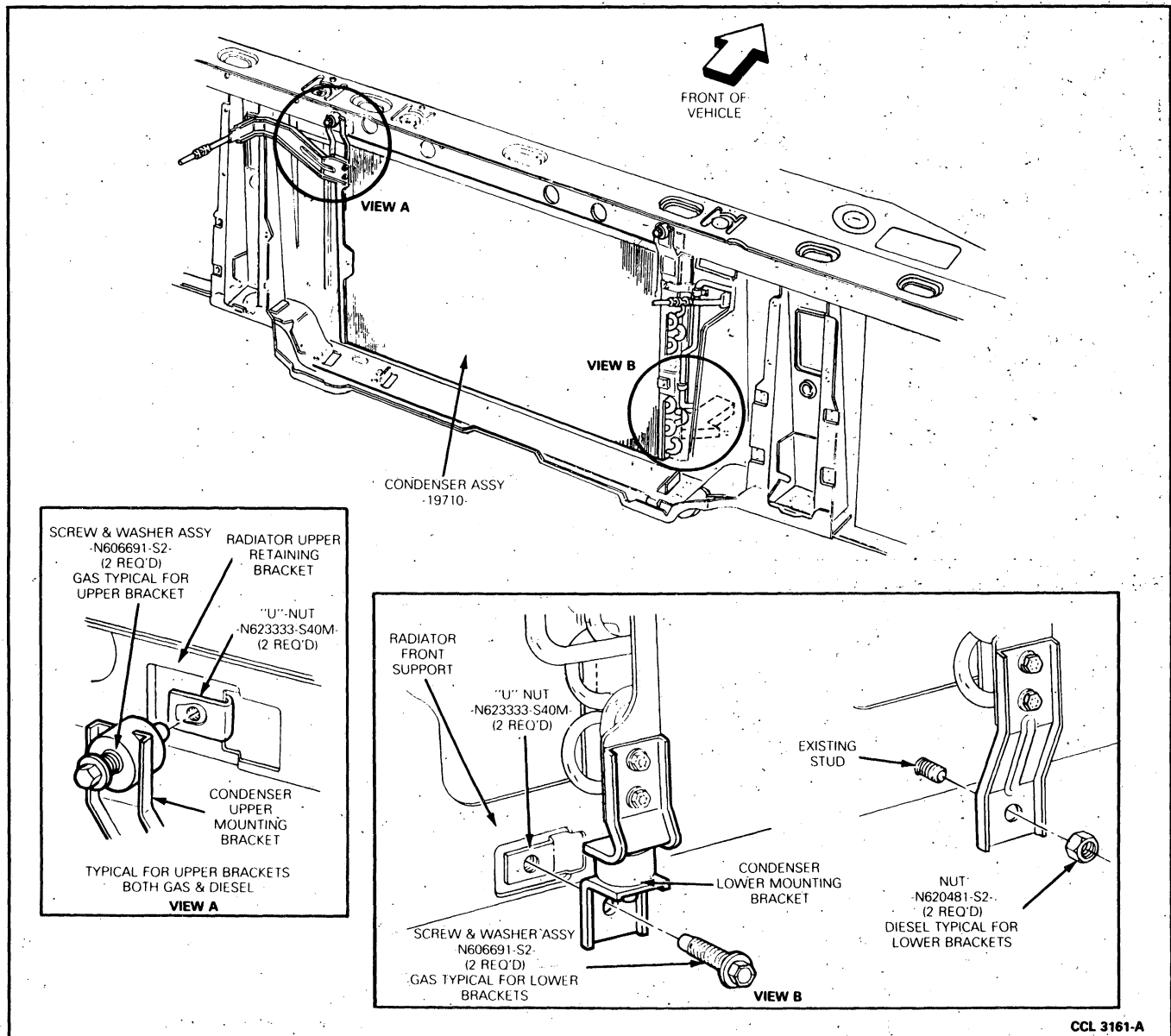


FIG. 48 Liquid Line to Condenser Attachment

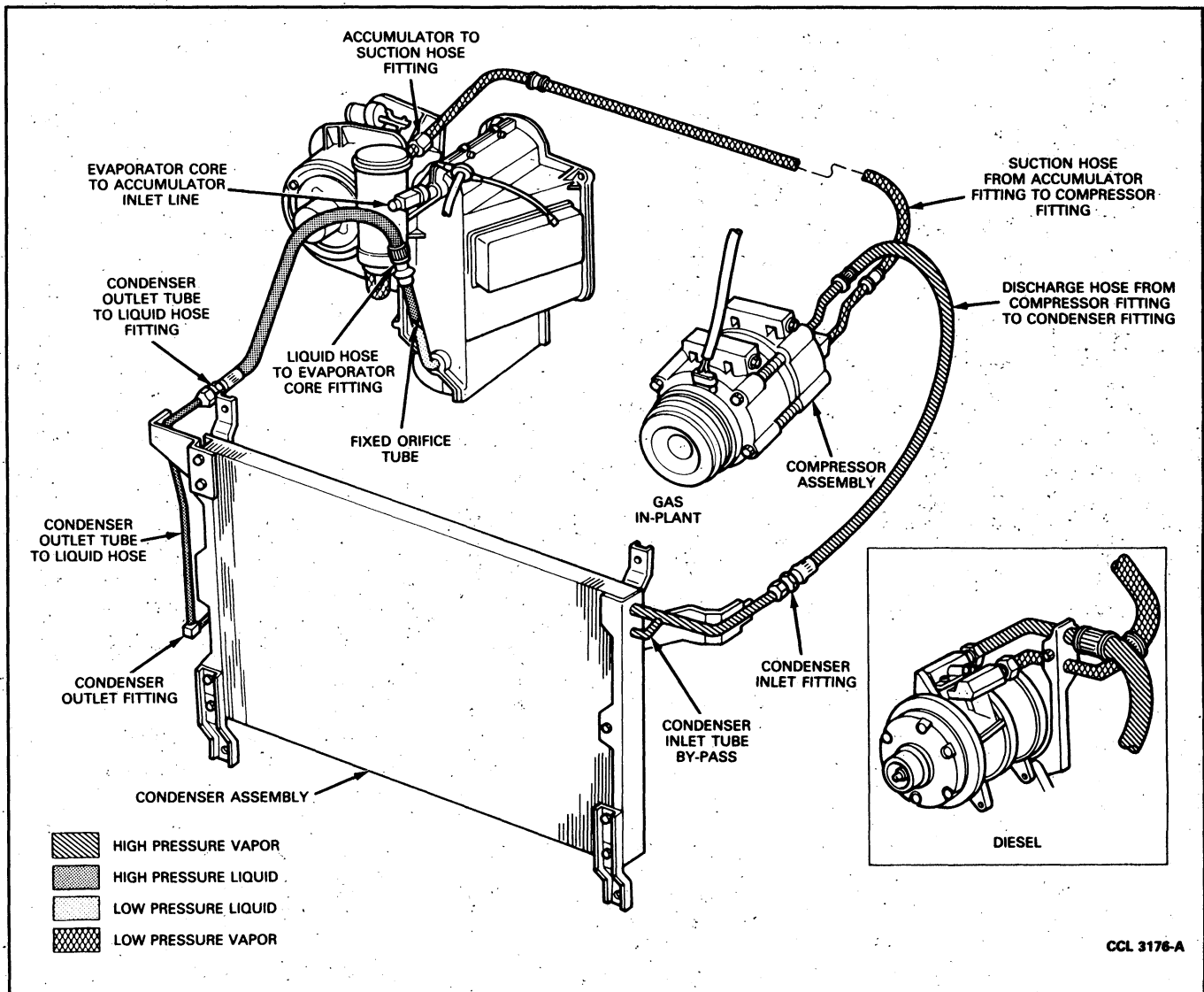


FIG. 49 Typical Refrigerant Line Installation

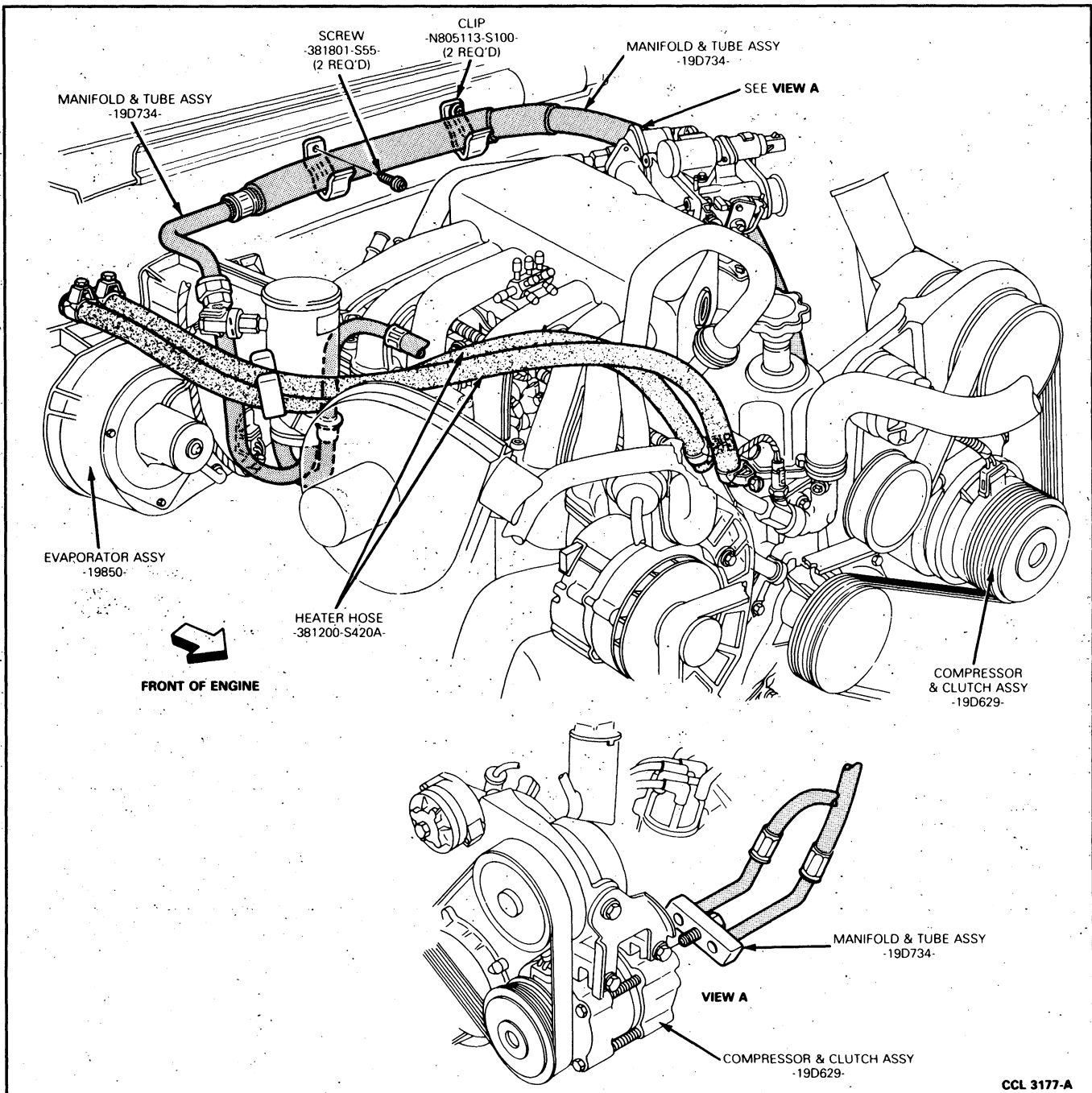


FIG. 50 Refrigerant and Heater Line Routing—4.9L (300 CID) EFI Engine

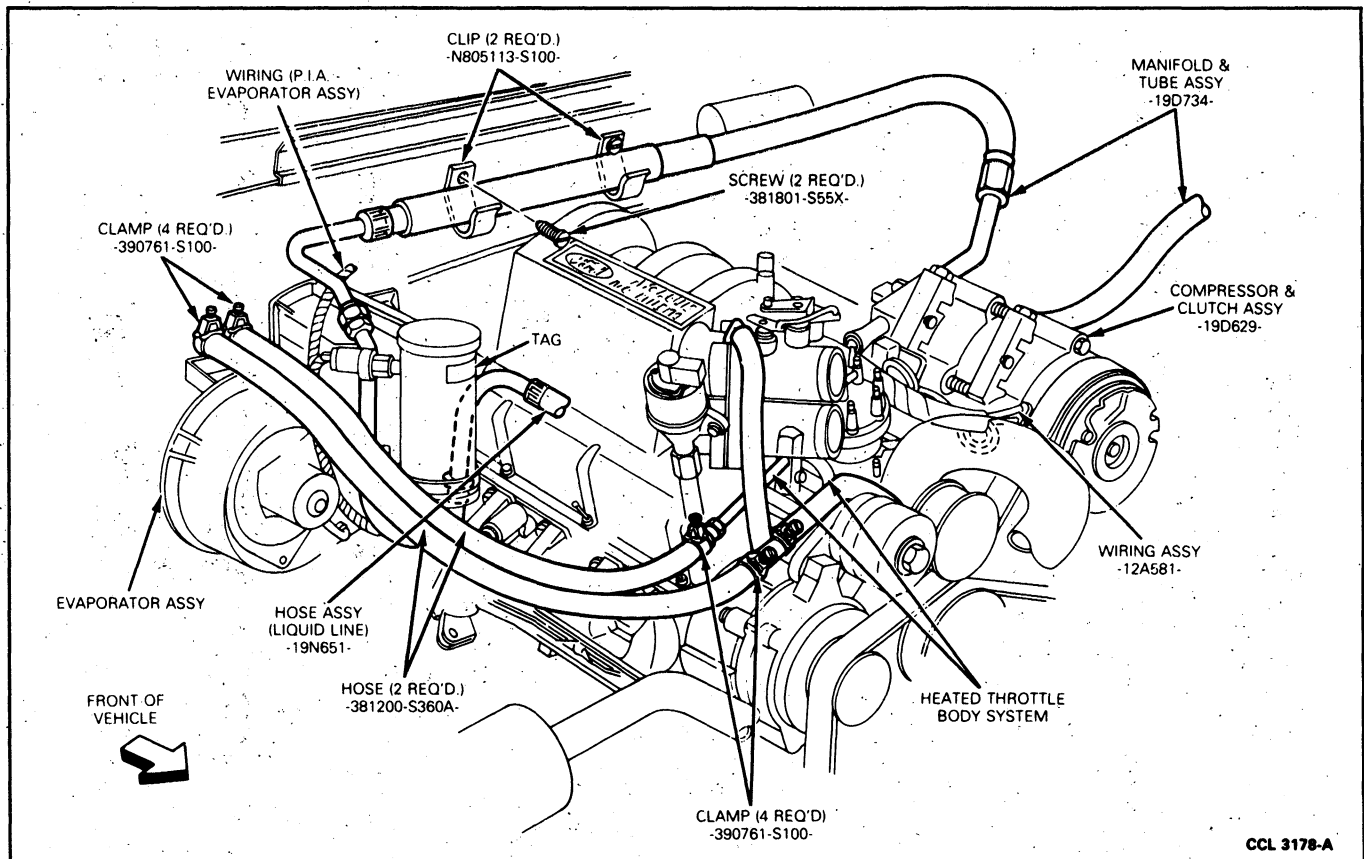


FIG. 51 Refrigerant and Heater Line Routing—5.0L (302 CID) EFI Engine)

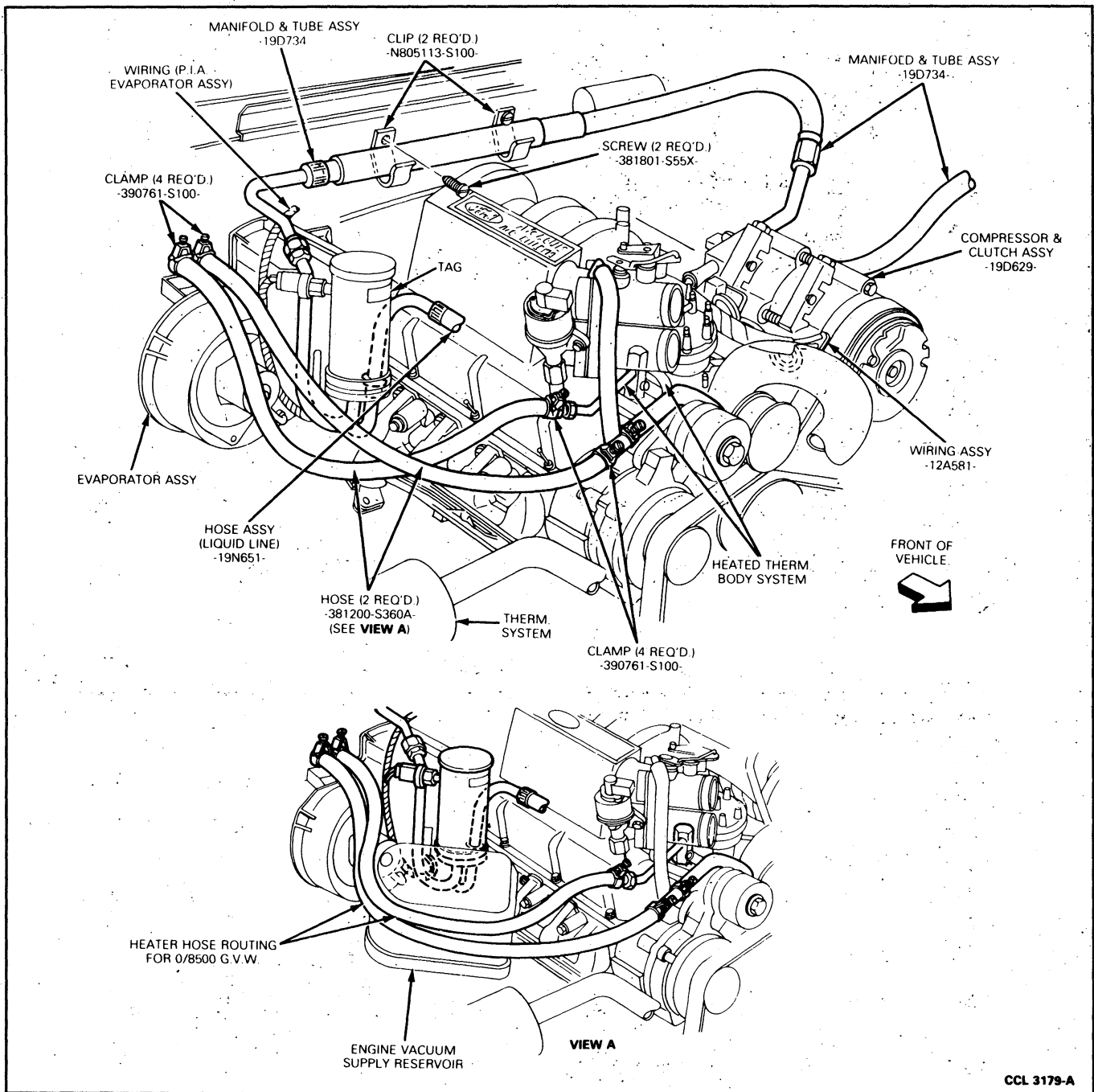


FIG. 52 Refrigerant and Heater Line Routing—5.8L (351 CID) EFI Engine

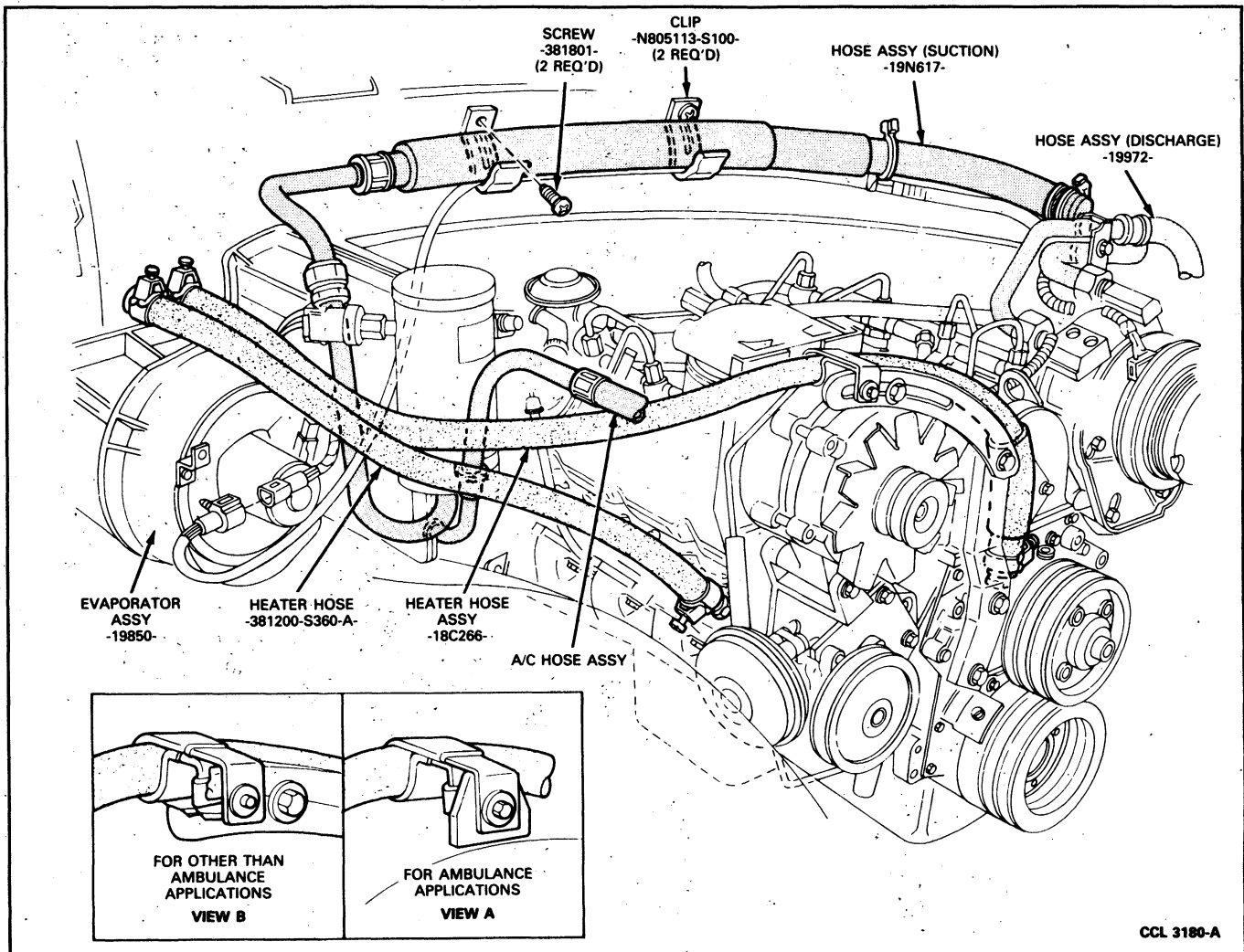


FIG. 53 Refrigerant and Heater Line Routing—5.8L (351 CID) EFI Engine

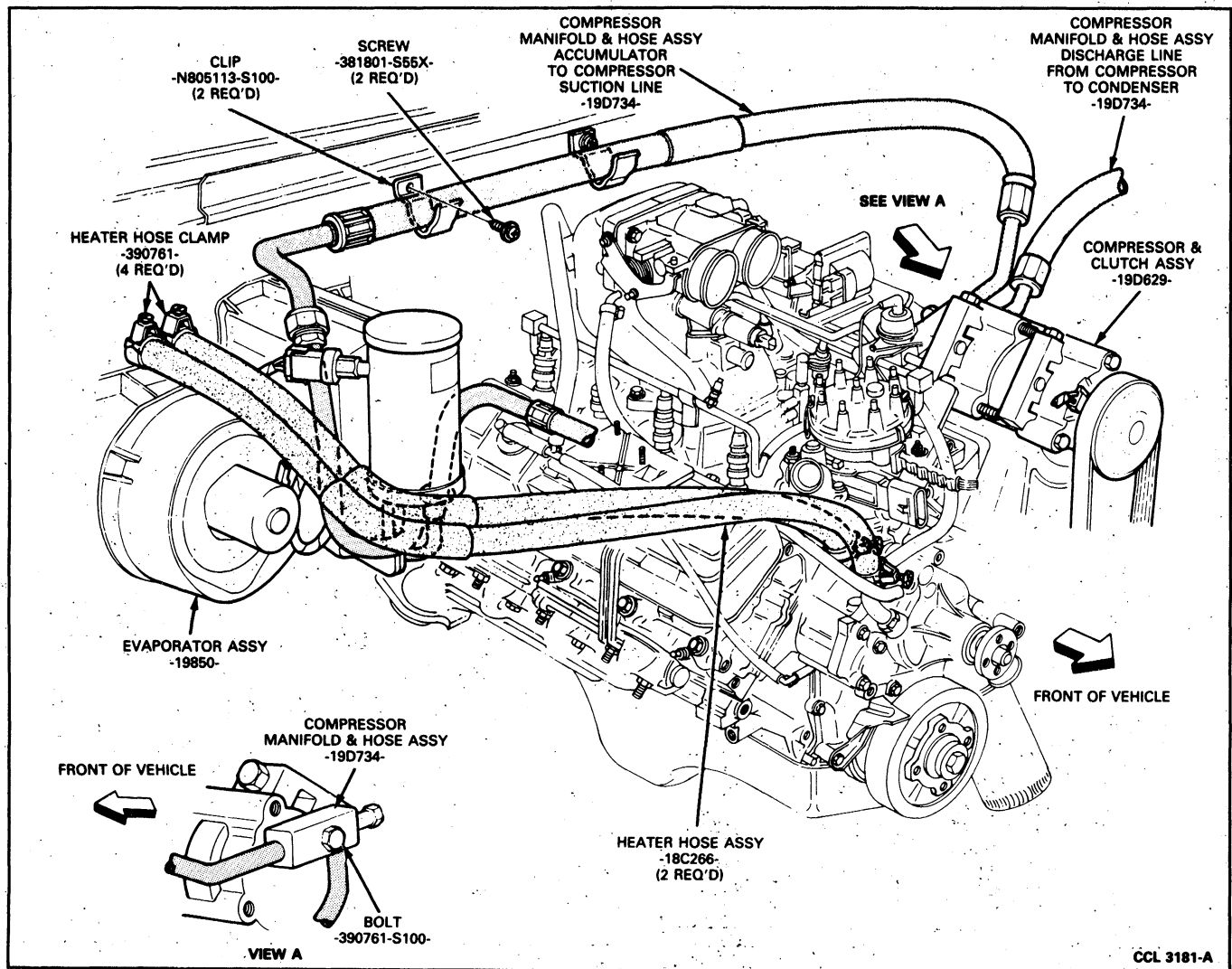
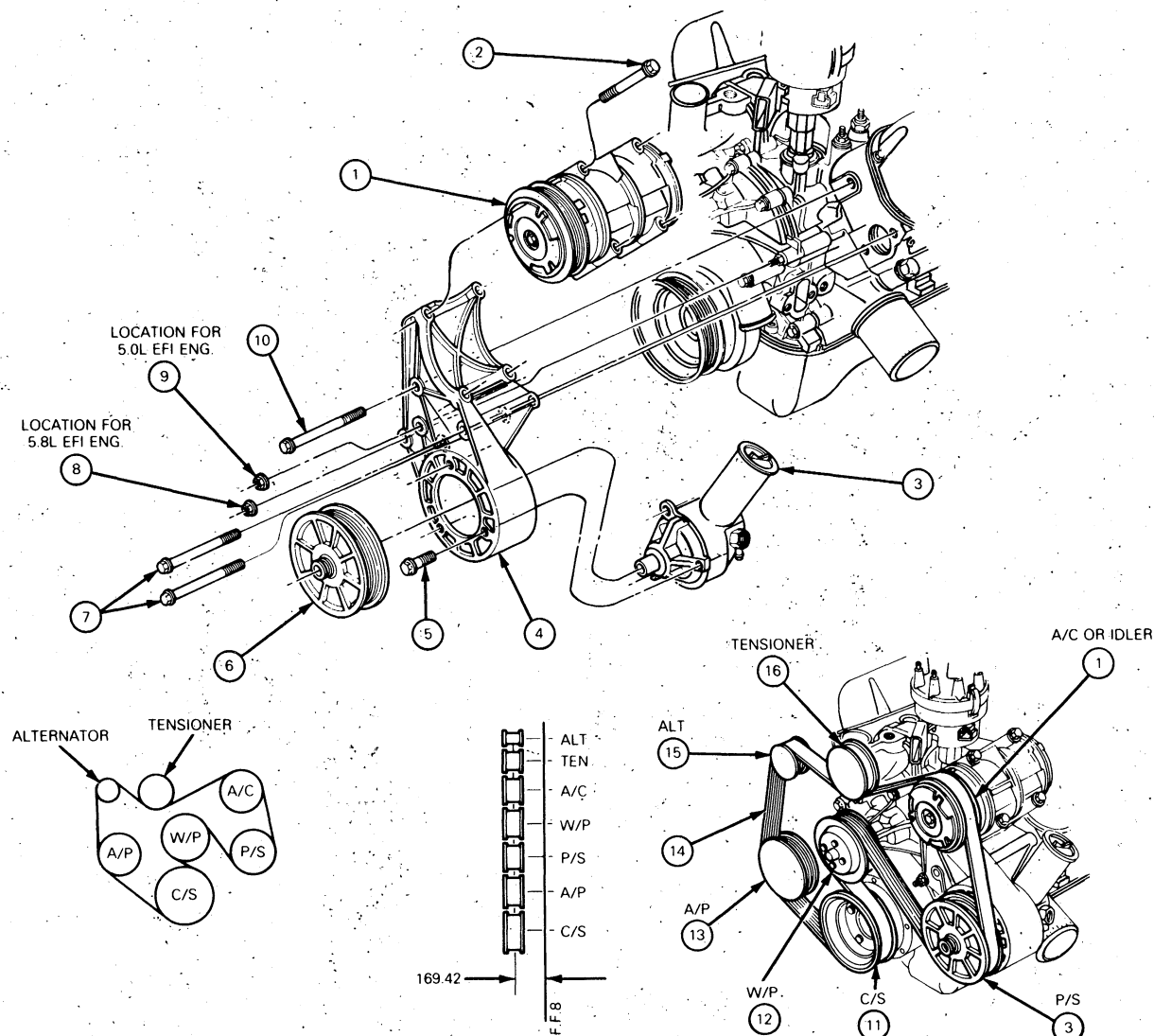


FIG. 54 Refrigerant and Heater Line Routing—7.5L (460 CID) EFI Engine



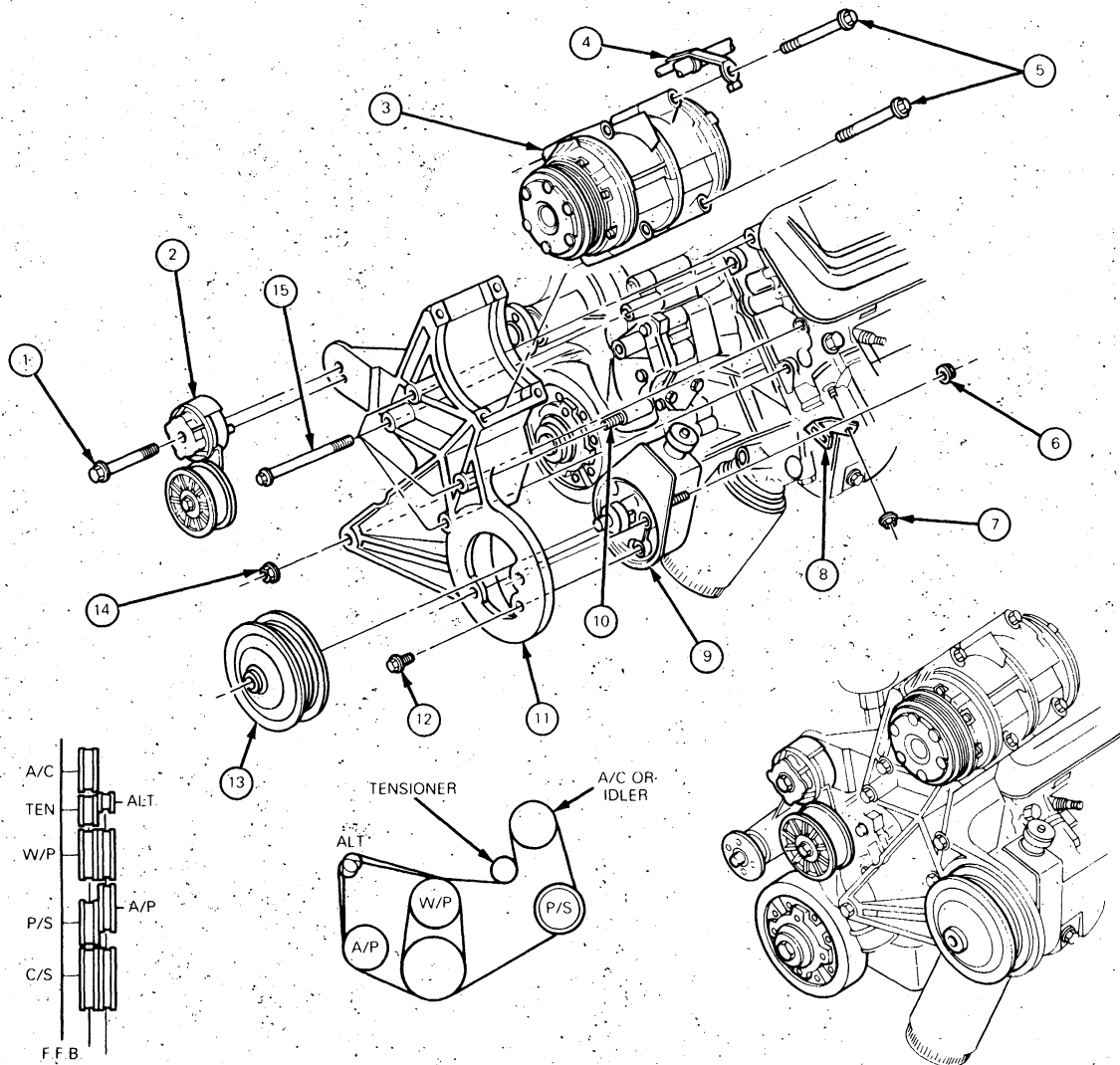


ITEM NO.	PART NAME
1	A/C CLUTCH & COMPRESSOR ASSY.
2	BOLT (19D629 TO 3C511)
3	P/S PUMP ASSY.
4	P/S PUMP SUPPORT BRACKET
5	SCREW
6	P/S PULLEY
7	BOLT (37511 TO ENGINE)
8	NUT (37511 TO ENGINE)
9	NUT (37511 TO ENGINE)
10	BOLT (37511 TO ENGINE)
11	CRANKSHAFT PULLEY ASSY.
12	WATER PUMP PULLEY ASSY.
13	AIR SUPPLY PUMP PULLEY
14	DRIVE BELT
15	ALTERNATOR
16	BELT TENSION ASSY.

BASIC PART NO.	QTY.
19D629	1
N606572-S2	4
3A674	1
3C511	1
N800199-S8M	3
3D673	1
56776-S2	3
382802-S2	1
382802-S2	1
56776-S2	3
6312	1
8A528	1
9A486	1
8620	*
10300	1
6B209	1

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FIG. 55 Compressor Installation 5.0L and 5.8L Engine



ITEM NO.	PART NAME	BASIC PART NO.	QTY.
1	BOLT (6B209 TO 19E708)	56192-S2	1
2	BELT TENSIONER ASSY	6B209	1
3	CLUTCH & COMPRESSOR ASSY	19D629	1
4	A/C BRACKET	19B890	1
5	BOLT (19D629 TO 19E708)	N606572-S2	4
6	NUT (3C718 TO 3A674)	N801206-S2	1
7	NUT (3C718 & 6750 TO 6007)	REF	REF
8	P/S PUMP BRACE	3C718	1
9	P/S PUMP	3A674	1
10	A/C COMPRESSOR & P/S PUMP BRACKET MOUNTING STUD	PIA ENGINE	
11	A/C COMPRESSOR & P/S PUMP BRACKET	19E708	1
12	SCREW (3A674 TO 19E708)	N800199-58M	3
13	P/S PULLEY ASSY	3D673	1
14	NUT (19E708 TO 6007)	382802-S2	1
15	BOLT (19E708 TO 6007)	56776-S2	4
	BOLT (19E708 TO 6007)	56576-S2	4

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FIG. 56 Compressor Installation—7.5L EFI Engine

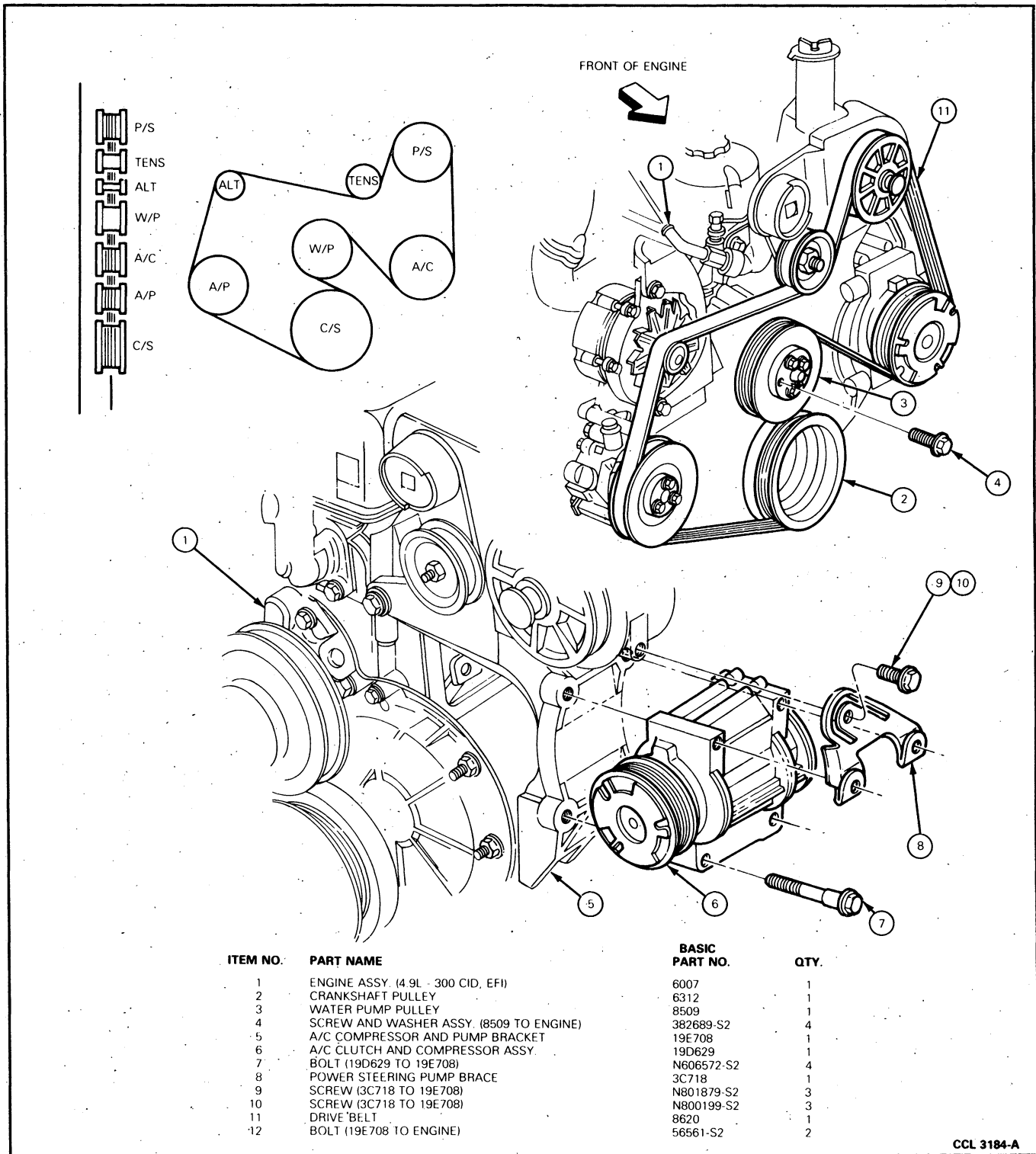


FIG. 57 Compressor Installation—4.9L EFI Engine

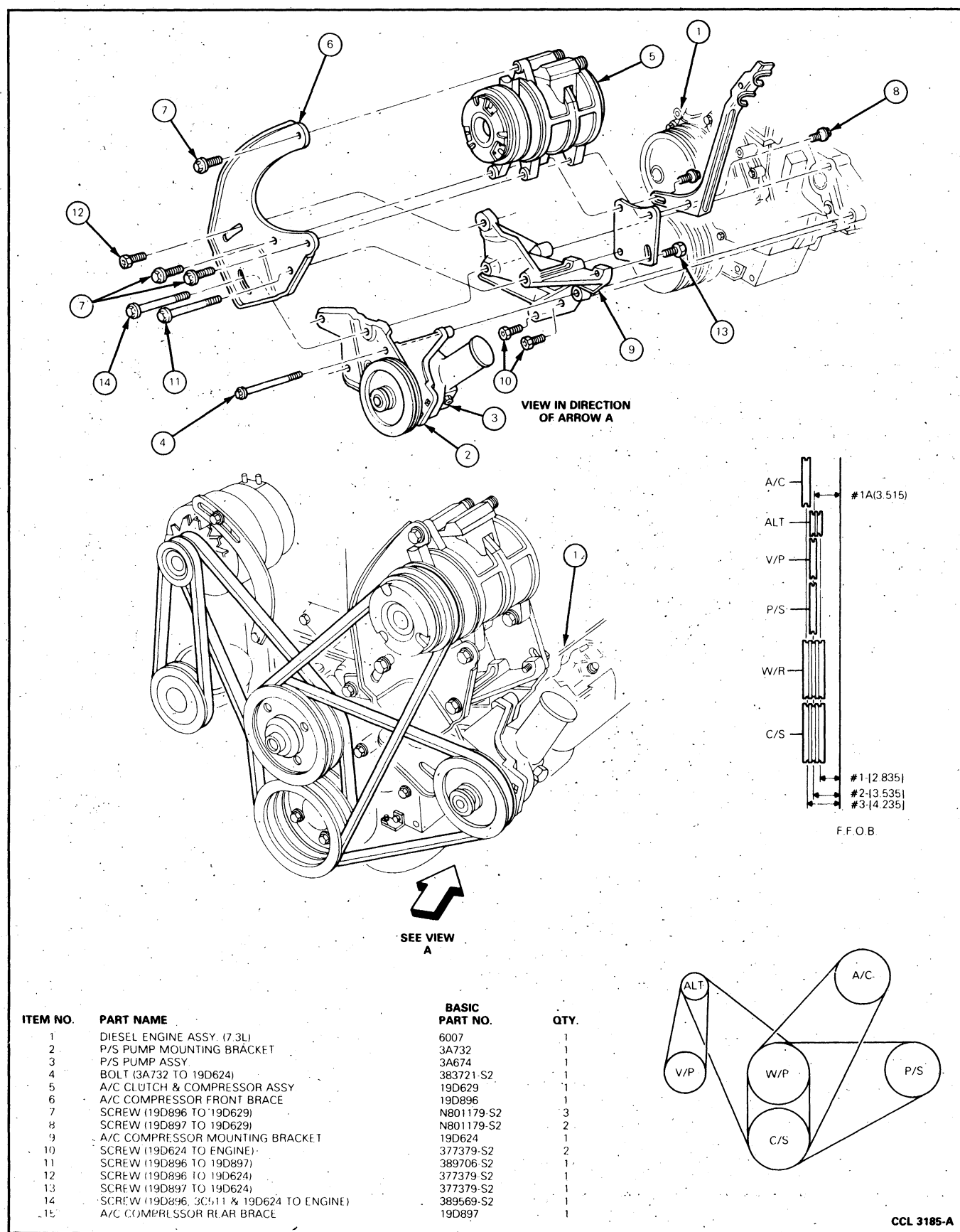


FIG. 58 Compressor Installation—7.3L Diesel Engine

## SPECIFICATIONS

### ELECTRICAL

Protective Device	30 Amp. Fuse F-15 (Lt. Green)		
	Thermal Limiter in Blower Resistor Circuit (Integral with Resistor)		
Blower Motor	<b>Blower Speed</b>	<b>Amps</b>	<b>Volts</b>
Current Draw	Low	6.0	5.0
(Amps and	Med. Low	8.0	7.0
Voltage)	Med. High	15.0	10.0
	High	25.0	12.8
Magnetic Clutch			
Current Draw —	Approximately 4.57 Amps @ 12.8 Volts		
Illumination			
Control Assembly	One ICP-161 Bulb		

### REFRIGERANT

System Protection			
Pressure Switch	Close Maximum 47 psi		
	Open Minimum 23 psi		
High Pressure Relief Valve	3103kPa (450 psi)		
(Located on Compressor			
Discharge Manifold)			
Maximum Capacity	3-1/4 Lbs. (1.47 kg)		
	52 Oz. (1474 g)		
Type			
Refrigerant 12 (R-12)	Dichlorodifluoromethane CCL <sub>2</sub> F <sub>2</sub>		
ESA-M17B2-A	Ford D4AZ-198519-A		
	Motorcraft YN-1A 14 Oz. Can		
	YN-7 30 Lb. Container		
Fixed Orifice Tube	0.062 inch		
	(Color Code-Red)		

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## SPECIAL SERVICE TOOLS

### SPECIAL SERVICE TOOLS

Tool Number	Description	Motorcraft
T63L-8620-A	Belt Tension Gauge	YT-371
D81L-19703-A	High Pressure Service Port Adapter Set	YT-354
T83P-18532-AH	Control Cable Remover	YT-1246
T83L-19990-A	Fixed Orifice Tube Remover and Installer	YT-1008
T83L-19990-B	Broken Orifice Tube Extractor	YT-1009
T81P-19623-G1	Spring Lock Coupling Disconnect Tool-3/8"	
T81P-19623-G2	Spring Lock Coupling Disconnect Tool-1/2"	
T83P-19623-C	Spring Lock Coupling Disconnect Tool-5/8"	

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### ROTUNDA EQUIPMENT

Model	Description	Motorcraft
023-00006	Flame-Type Leak Detector	YT-202
023-00007	Dial Thermometer	YT-227
055-00015	Electronic Leak Detector	YT-288
021-00014	Hand Operated Vacuum Pump Tester	YT-335

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# SECTION 36-65 Air Conditioning System

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Temperature Control Cable .....	36-65-15	Control Assembly .....	36-65-15
<b>DESCRIPTION</b>		Defroster Nozzle .....	36-65-17
Control Assembly .....	36-65-1	Heater Hose and A/C Line Routing .....	36-65-34
<b>DIAGNOSIS AND TESTING</b>		Instrument Panel .....	36-65-16
Blower Motor Voltage Test .....	36-65-6	Left Register Panel Assembly .....	36-65-18
<b>OPERATION</b>		Outside/Recirculating Air Door Vacuum	
Vacuum System .....	36-65-5	Motor .....	36-65-20
<b>REMOVAL AND INSTALLATION</b>		Resistor Assembly .....	36-65-22
7.3L Diesel Engine (6E171		Suction Accumulator/Drier .....	36-65-29
Compressor) .....	36-65-33	V-8 Gasoline Engines .....	36-65-31
Blower Switch .....	36-65-15	Vacuum Motors .....	36-65-21
Center Register Panel Assembly .....	36-65-18	Vacuum Selector Valve .....	36-65-15
Clutch Cycling Pressure Switch .....	36-65-21	<b>SPECIFICATIONS</b> .....	36-65-41
Compressor Assembly .....	36-65-31	<b>VEHICLE APPLICATION</b> .....	36-65-1
Compressor Clutch and Field Coil .....	36-65-34		

## VEHICLE APPLICATION

E-150 Through E-350 Vehicles.

## DESCRIPTION

This Section covers the controls and components of the manually operated A/C-heater system. Section 36-30, Air Conditioning System General Service, provides information and service procedures regarding refrigerants. Depending on the service operation being performed, reference to both of these sections in the manual may be necessary.

The air conditioner used in the E-150—E-350 is a combination air conditioning and heating system referred to as a blend air design. The system, excluding the plenum and ducts, consists of a two-piece A/C-heater assembly. Both pieces assemble to each other and to the dash panel on the RH side of the vehicle. One part extends into the engine compartment and the other is in the passenger compartment under the instrument panel. The plenum and ducts to the registers and defrosters are located behind the instrument panel. Refer to Figure 1.

The control assembly is located in the instrument panel at the right of the steering column. Four registers in the instrument panel direct airflow into the passenger compartment. The louvers in the registers can be adjusted to direct airflow upward, downward, to the right or to the left. They can also be set in a closed position which will block nearly all airflow.

### Control Assembly

Climate control equipment on Econoline is available as a heater-only system, or a combined A/C and heater system. An auxiliary system is also available to provide increased climate control in the passenger area located rearward of the front seats. Section 36-70 covers the servicing as well as certain restrictions which apply to the application of an auxiliary system.

The control assembly used with or without an auxiliary system is shown in Fig. 2.

### Function Selector Lever

The function selector lever actuates an eight-port vacuum selector that controls vacuum motors at the floor/defrost, panel/defrost, and outside/recirc air doors. The function selector lever also controls the blower switch OFF-ON operation and activates the A/C clutch circuit in the A/C position.

In either A/C position (MAX or NORM), compressor operation is dependent upon the clutch cycling pressure switch.

The cutout pressure is approximately 169 kPa (24.5 psi). Cut-in pressure is approximately 300 kPa (43.5 psi).

### Temperature Selector Lever

The temperature selector lever actuates a control cable which operates the temperature blend door.

### Blower Control Switches

A four-speed blower control switch with a range between LO and HI is located at the LH side of the control assembly. To completely stop blower operation, it is necessary to move the function selector lever to its OFF position. If the vehicle is equipped with auxiliary air, a second blower control switch will be included. This switch is installed near the right end of the control. It provides four blower speeds plus an OFF position.

### Blower Motor Resistor

The blower motor resistor assembly attaches to the evaporator case in the area near the dash panel and heater core tubes (Fig. 3).

### Evaporator Assembly

Refer to Fig. 4 for an evaporator assembly illustration.

The heater core and blend air door are housed in the evaporator core rear housing. The blower motor and wheel, blower motor resistor, and evaporator core are located in the evaporator assembly.

When servicing any of these components it is not necessary to loosen or remove the instrument panel.

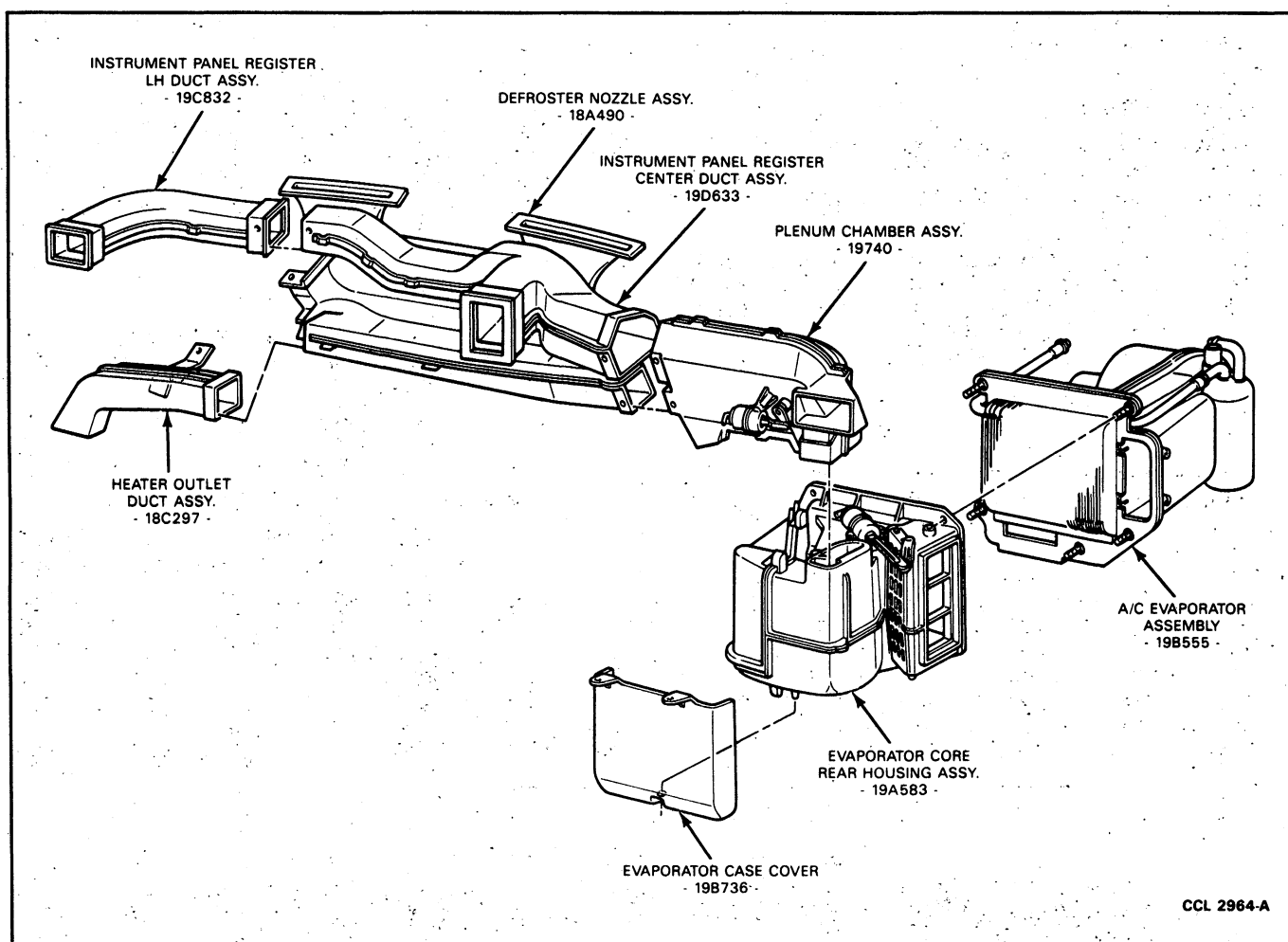


FIG. 1 Manual A/C—Heater System

The suction accumulator/drier and its component clutch cycling pressure switch attach to the evaporator case.

### Fixed Orifice Tube

The fixed orifice tube regulates the flow of refrigerant into the evaporator. It is the dividing point in the refrigerant system between high and low pressure. Refer to Figure 5.

Econoline vehicles are equipped with an orifice tube that is color-coded orange. It is also identified as an 0.057-inch tube. This dimension is the inside diameter of the short brass tube which protrudes inside the transparent surface of the orifice tube assembly.

### Suction Accumulator/Drier

Refer to Fig. 6.

Refrigerant enters the assembly through the inlet tube and the heavier oil-laden refrigerant falls to the bottom of the canister. A small diameter bleed hole is located in the side of the outlet tube near the bottom of the canister. This bleed hole is covered with a filter and allows a small amount of the heavier liquid refrigerant and oil mixture to re-enter the suction line at a controlled rate. When the heavier liquid refrigerant and oil mixture enters the compressor suction line, it has a second opportunity to vaporize and circulate through the compressor without causing damage to the compressor due to refrigerant slugging.

A desiccant bag is mounted inside the suction accumulator/drier canister to absorb any moisture which may be in the refrigerant system.

A fitting located on the top of the canister is used to attach the clutch cycling pressure switch. A long travel Schrader-type valve stem core is installed in the fitting opening to prevent refrigerant loss when the clutch cycling pressure switch is removed.

### OPERATION

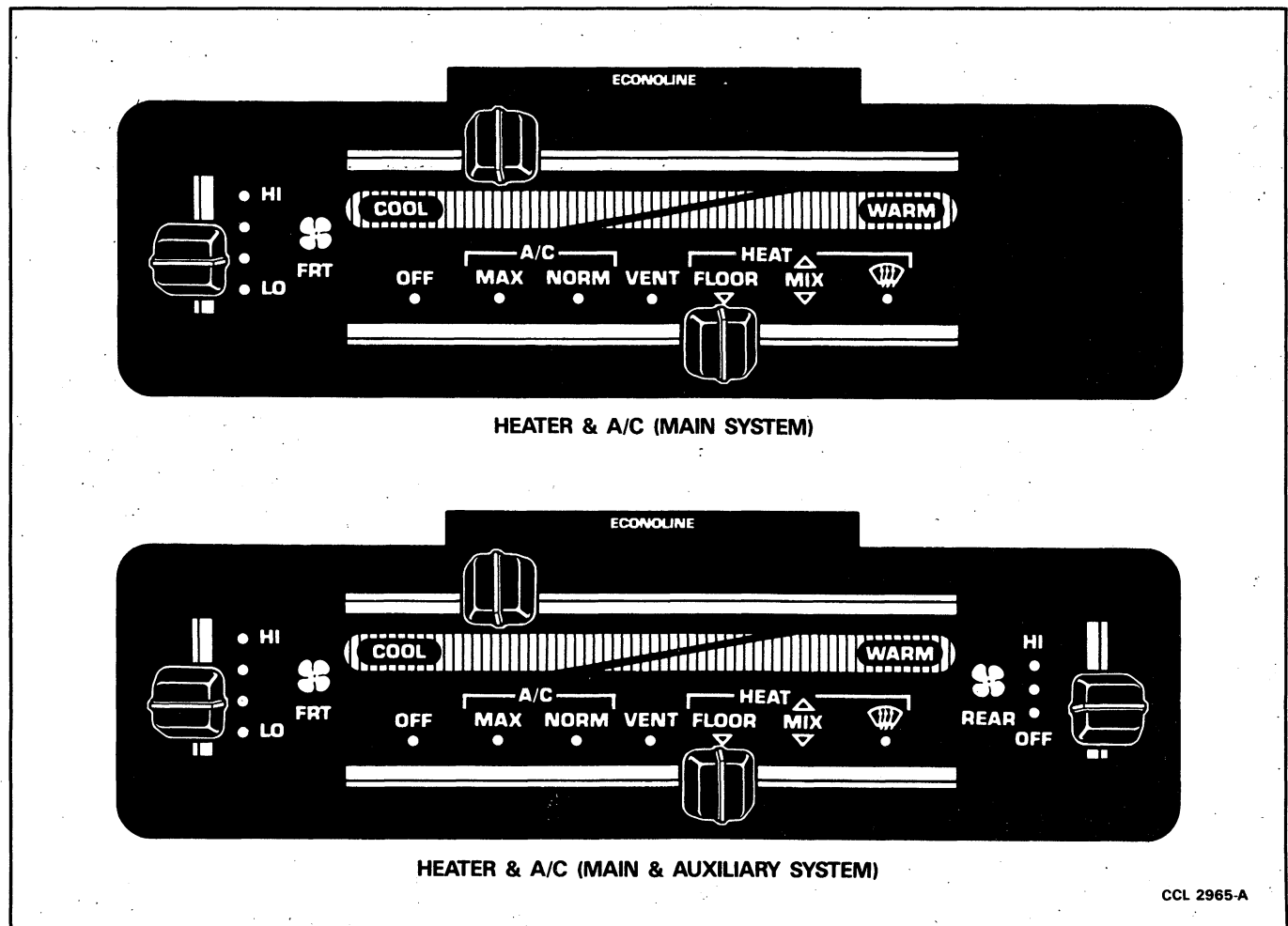
Refer to Figs. 7 and 8.

There are several control levers and switches which are involved in the operation of an Econoline climate control system. They are as follows:

- Function Selector Lever
- Temperature Selector Lever
- Blower Control Switch or Switches

The control assembly face plates illustrated in Figs. 7 and 8 show where the levers and switches are located.

The main blower is turned on whenever the function selector lever is not in the OFF position. The A/C compressor clutch is actuated whenever the function selector lever is in the MAX or NORM A/C position. Cycling of the compressor is then controlled by a clutch cycling pressure switch on the suction accumulator/drier. This drier attaches to the side portion of the



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FIG. 2 Control Assembly



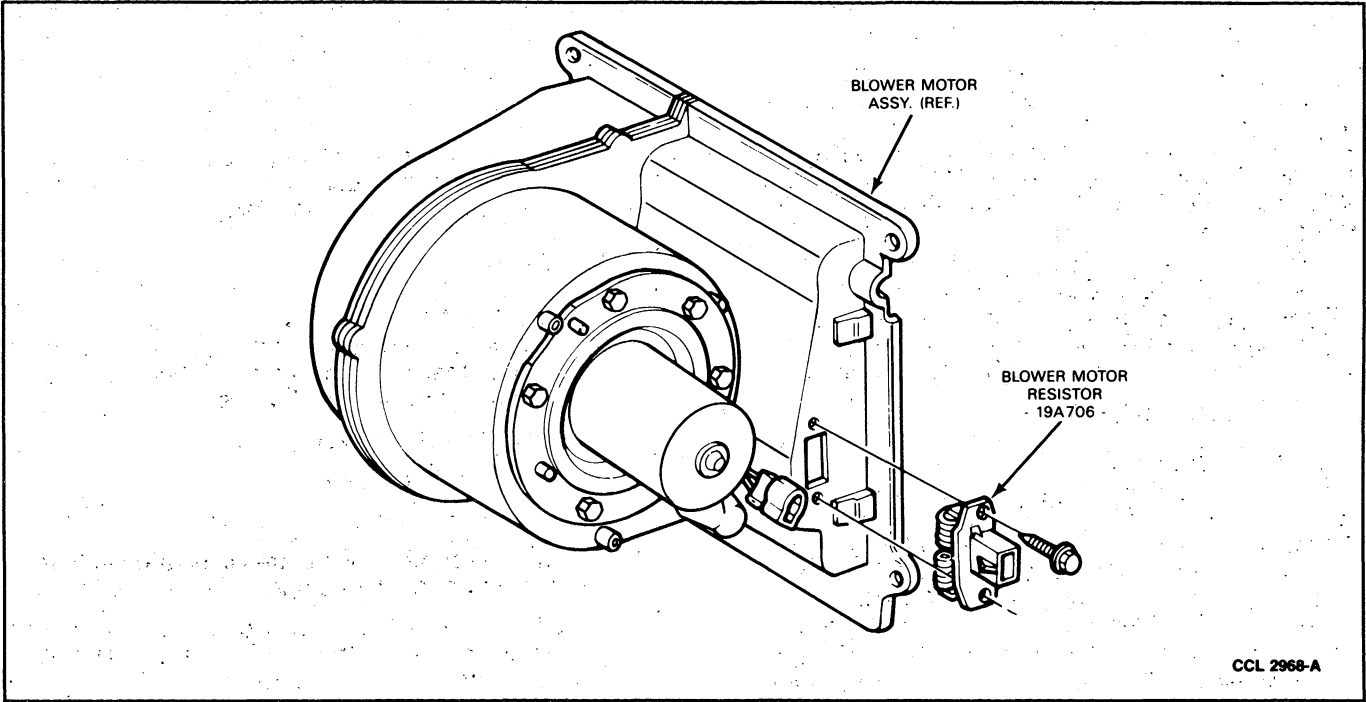


FIG. 3 Blower Motor Resistor

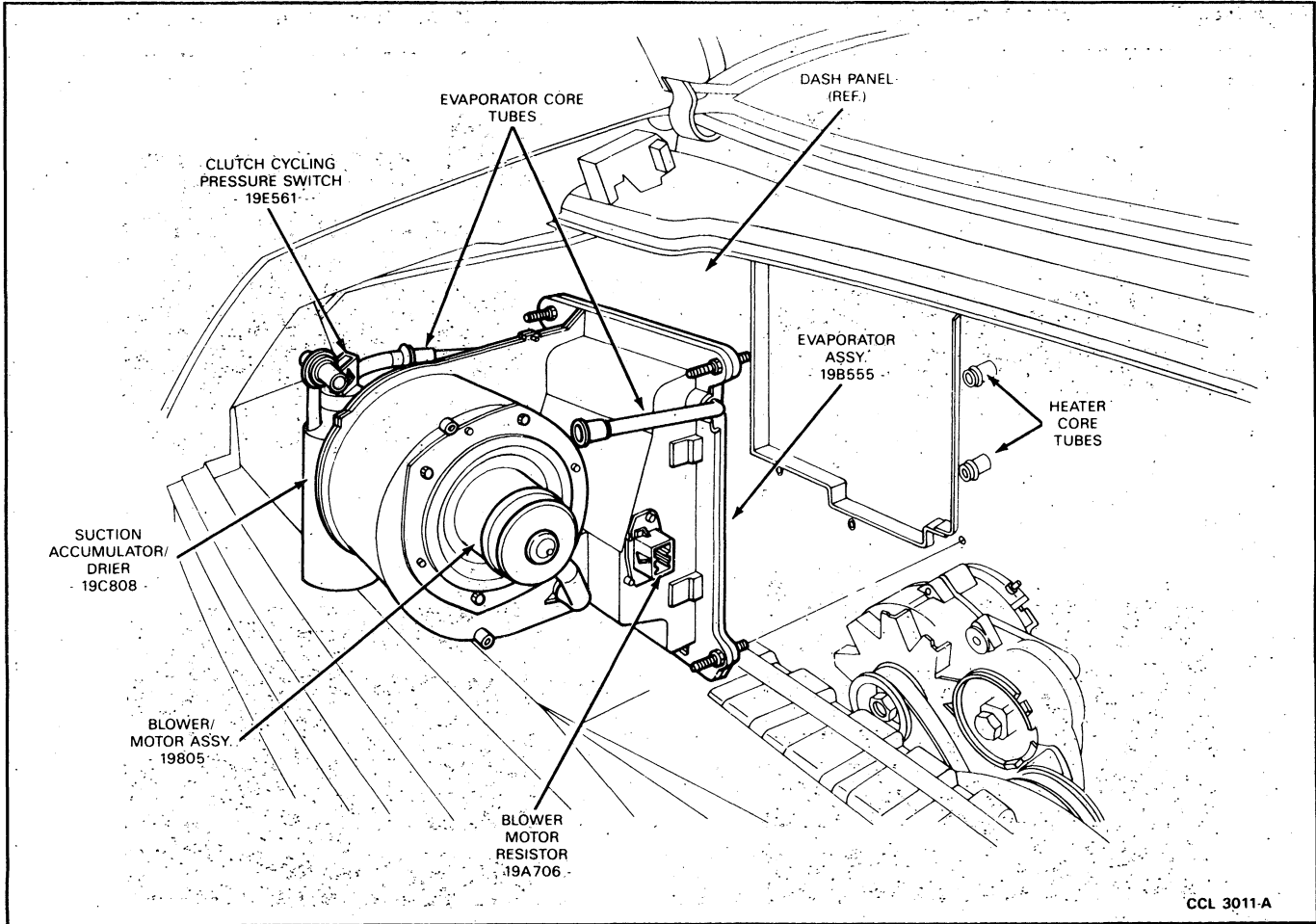


FIG. 4 Evaporator Assembly—Installation

evaporator case which extends into the engine compartment.

Other positions, VENT, FLOOR, MIX or DEFROST may be selected by moving the function selector lever to the appropriate detent. This actuates a vacuum selector valve which is part of the control assembly. Vacuum lines from this valve lead to vacuum motors which operate all doors in the system except the cable-controlled temperature air door.

### Airflow

Air is drawn into the system by the blower motor and wheel through the outside-recirc door opening. The air is then blown through the evaporator core and then the heater core (when the temperature lever is moved toward the WARM position). When the cable operated temperature blend door is in the maximum COOL position, the air bypasses the heater core. When the temperature lever is moved to the right, away from the maximum COOL position, a small percentage of air passes through the heater core where it is warmed, and then mixed with the cool air before it is discharged through the registers.

With the function selector lever in the OFF position, the outside-recirc door is in the recirculated air position. It is closed to outside air and no air passes through the system. The blower motor is off.

In the MAX A/C position, the outside-recirc air door is in the recirculated air position. All of the air discharges through the panel registers except for a small amount of floor bleed. The compressor operates in this function lever setting.

In the NORM A/C position the outside-recirc air door is open to the outside (no vacuum) and outside air is discharged through the panel register with a small amount of floor bleed. The compressor operates in this lever setting.

In the VENT position the outside-recirc air door is open to the outside (no vacuum), and outside air is discharged through the panel registers except for a small amount of floor bleed. The compressor does not operate in this control lever setting.

In the FLOOR position, the outside-recirc air door is open to outside air (no vacuum). Air is discharged through the floor outlets plus a small amount of defroster bleed is directed to the windshield.

In the MIX position air is discharged through both the defroster and floor outlets.

In the DEFROST position the air is discharged through the defrosters to the windshield. There is also a small amount of floor bleed. The compressor operates in this control setting to help dehumidify the air.

### Vacuum System

Figure 9 illustrates the vacuum circuit which controls the movement of three of the four doors in the system. These doors are:

- Outside-Recirc Air Door
- Panel/Defrost Door
- Floor/Defrost Door

The temperature control door (blend air door) is cable controlled.

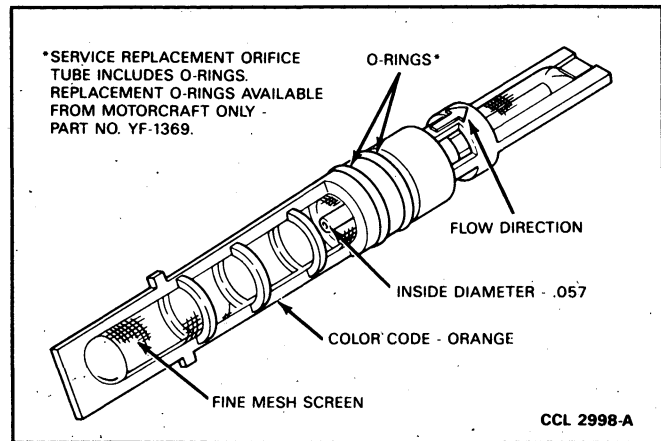


FIG. 5 Fixed Orifice Tube

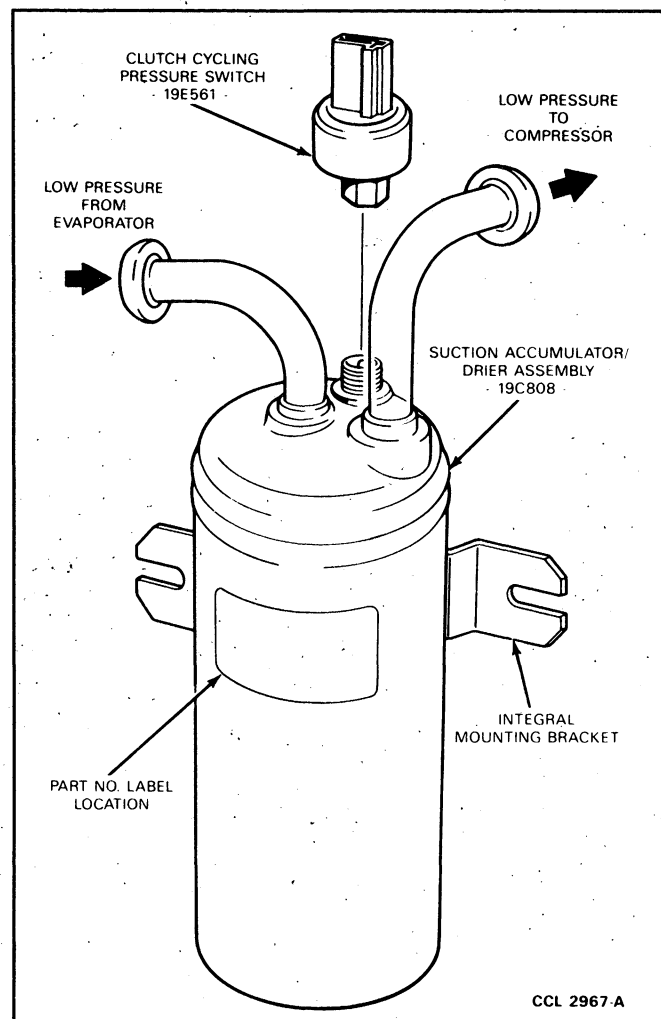


FIG. 6 Suction Accumulator/Drier

### Refrigerant Flow

Figure 10 is a simplified illustration of refrigerant flow through an A/C circuit.

The boiling or condensing temperature of a refrigerant increases or decreases according to the pressure exerted on it.

In the E-150—E-350 air conditioning system, liquid refrigerant (R-12) is delivered under high pressure from

the condenser to the orifice tube located in the evaporator inlet tube. When the refrigerant passes through the orifice tube, its pressure drops and its temperature reverts to its approximate boiling point (-21.6° to -29.8°F). As the refrigerant flows through the evaporator coils, warm passenger compartment air, or outside air, passes over the **outside surface** of the coils. As it boils, the colder R-12 absorbs heat from the air and thus cools the passenger compartment. The heat from the air is absorbed by the boiling refrigerant which is converted to a gas. The refrigeration cycle is now under way. To complete the cycle, the following remains to be done:

1. Dispose of the heat in the gas.
2. Convert the gas back to liquid for re-use.
3. Return the liquid to the starting point in the refrigerant cycle.

The compressor pumps the gas and liquid out of the evaporator into the suction line to the accumulator/drier which stores any liquid which may have entered the system. The drier then allows gas only to return to the compressor. The compressor forces the gaseous refrigerant under high pressure and temperature into the condenser which is located in the outside air stream at the front of the vehicle. The temperature of the gas entering the condenser is higher than that of the outside air. As the heat transfers from the hot gas to the cooler air, the R-12 condenses back to a liquid. The liquid under high pressure now returns to the orifice tube in the evaporator inlet line to repeat its flow cycle.

### Spring Lock Couplings

The spring lock coupling is a refrigerant line coupling held together by a garter spring inside a circular cage. When the coupling is connected, the flared end of the female fitting slips behind the garter spring inside the cage of the male fitting. The garter spring and cage then prevent the flared end of the female fitting from pulling out of the cage (Fig. 11).

Two O-rings are used to seal between the two halves of the coupling. These O-rings are made of a special material and must be replaced with an O-ring made of the same material. The O-rings normally used in the refrigerant system connections are not the same material and should not be used with the spring lock coupling. Use only the O-rings listed in the master parts catalog for the spring lock coupling. They are available in E35Y-19D690-A Kit.

A plastic indicator ring is used on spring lock couplings to indicate, during vehicle assembly, that the coupling is connected. Once the coupling is connected, the indicator ring is no longer necessary but will remain captive by the coupling near the cage opening.

The indicator ring may also be used during repair operations to indicate connection of the coupling. After a coupling has been cleaned and new O-rings have been installed and lubricated with clean refrigerant oil, insert the tabs of the indicator ring into the cage opening. Then, connect the coupling by pushing it together with a slight twisting motion. When the coupling is connected, the indicator ring will snap out of the cage opening but will remain captured on the coupling by the refrigerant line.

### Side-Mounted Auxiliary Climate Control Systems

Refer to Section 36-70 for information pertaining to the E-150—E-350 Side Mounted Auxiliary Heater and/or Air Conditioning System.

## DIAGNOSIS AND TESTING

### Blower Motor Voltage Test

The manual A/C-heater system blower motor electrical circuit uses ground side switching. When performing blower motor voltage tests on systems with ground side switching, the voltage reading must be taken across the motor wires.

#### Test Procedure

1. Place the temperature selector lever in the WARM position.
2. Place the function selector lever in the FLOOR position.
3. Insert the probes of a voltmeter into the wire holes of the motors two hardshell connectors and make contact with the wire terminals. Measure the voltage drop across motor.
4. With the engine running (battery voltage of approximately 14.2 volts), the voltage reading should be within specified range for each blower switch position as indicated in the blower switch chart of the electrical wiring diagram (Fig. 12).

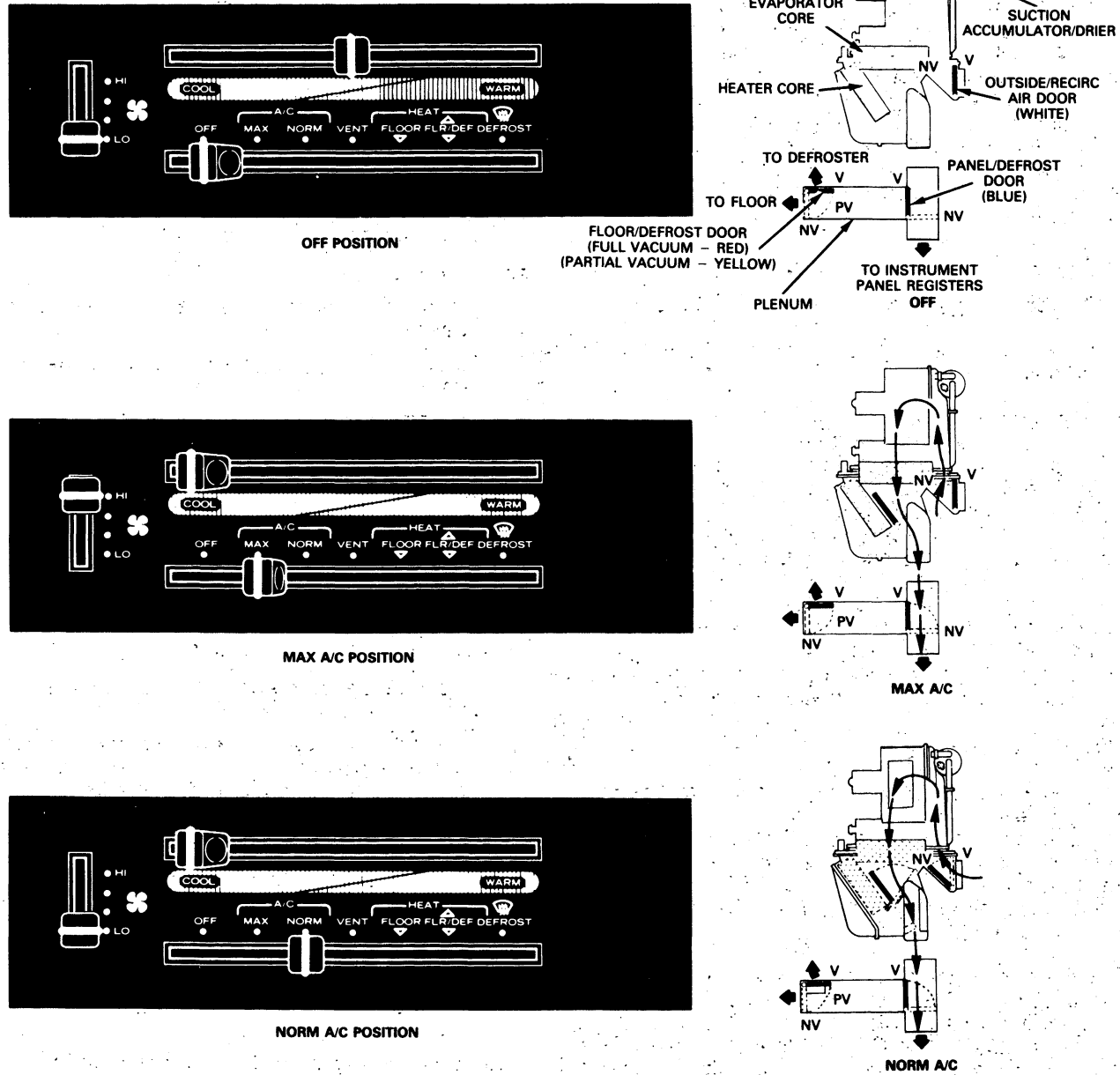
### Blower Motor Current Draw Test

1. Separate the blower motor ground (black) wire at the blower motor resistor.
2. Connect the positive (+) ammeter lead to the female spade connector and the negative (-) ammeter lead to the resistor terminal.
3. Place the temperature selector lever in the mid-position and the function selector lever in a HEAT position to turn the blower on.
4. Turn the ignition switch to the RUN position.
5. With a fully charged battery, the blower motor current draw (amps) should be approximately as indicated for each blower speed in the blower switch chart of the electrical wiring diagram (Fig. 12).

Heat can be transferred from a comparatively cooler passenger compartment to the hot outside air because of the difference between the refrigerant pressure in the evaporator and the pressure in the condenser. At the evaporator, the orifice tube reduces the pressure and thereby reduces the boiling point below the temperature of the passenger compartment. Thus, heat transfers from the passenger compartment to the boiling refrigerant. In the condenser, the compressor raises the condensation point above the temperature of an outside air. Thus, the heat transfers from the condensing refrigerant to the outside air. The orifice tube and the compressor simply create pressure conditions that permit the laws of thermodynamics to provide the desired cooling effects.

### Vacuum System Tests

To test the A/C-heater control system, start the engine and move the function selector lever slowly from one position to another. A momentary hiss should be heard as the function selector lever is moved from one position to another indicating that vacuum is available at



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**FIG. 7 Airflow Diagram (OFF, MAX A/C, NORM A/C Positions)**

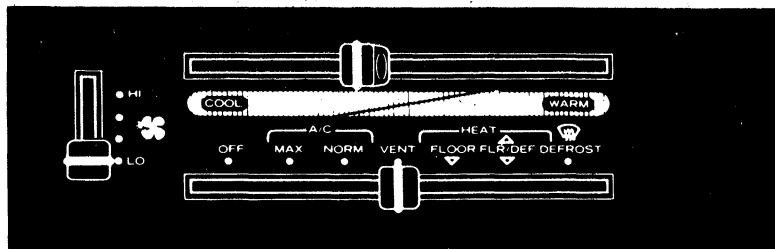
the control assembly. A continuous hiss at the control assembly indicates a major leak somewhere in the system. It does not necessarily indicate that the leak is at the control assembly (Fig. 9).

If a momentary hiss cannot be heard when the function selector lever is moved from one position to another, check for a kinked, pinched or disconnected vacuum supply hose (Fig. 9). Also inspect the check valve between the intake manifold and the vacuum reservoir to be sure it is working properly.

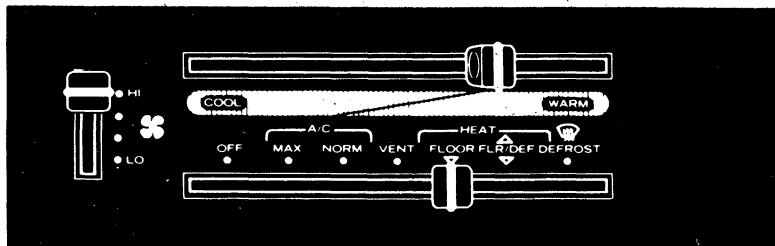
If a momentary hiss can be heard when the function selector lever is moved from one position to another, vacuum is available at the control assembly. Then, cycle the function selector through each position with the blower on HI and check the location(s) of the

discharge air. The airflow schematic and vacuum control chart shown in Fig. 9 indicates which vacuum motors are applied for each position of the function selector lever along with an airflow diagram of the system. The airflow diagram shows the position of each door when vacuum is applied and when there is no vacuum applied. With this chart, airflow for each position of the control assembly can be determined. If a vacuum motor fails to operate, the inoperative motor can readily be found because the airflow will be incorrect.

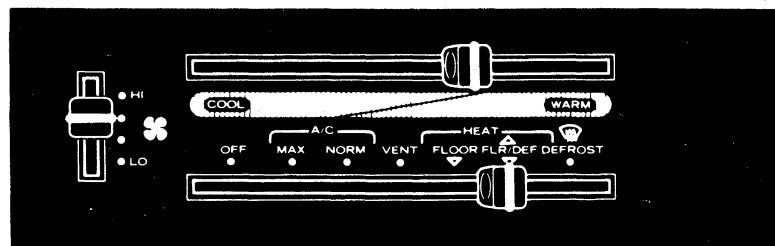
If a vacuum motor is inoperative, check the operation of the motor with Rotunda Vacuum Tester 021-00014 or equivalent. If the vacuum motor operates properly, the



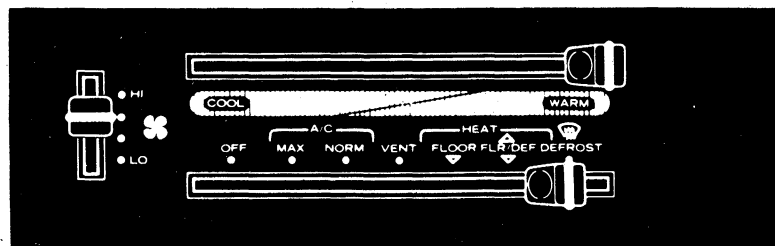
VENT POSITION



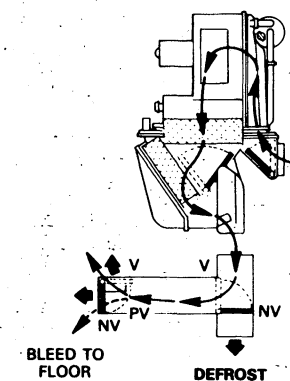
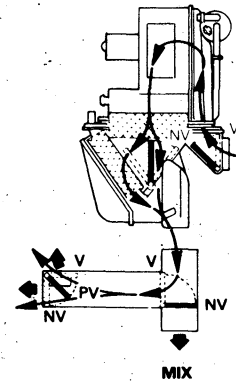
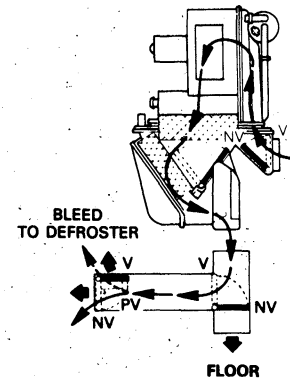
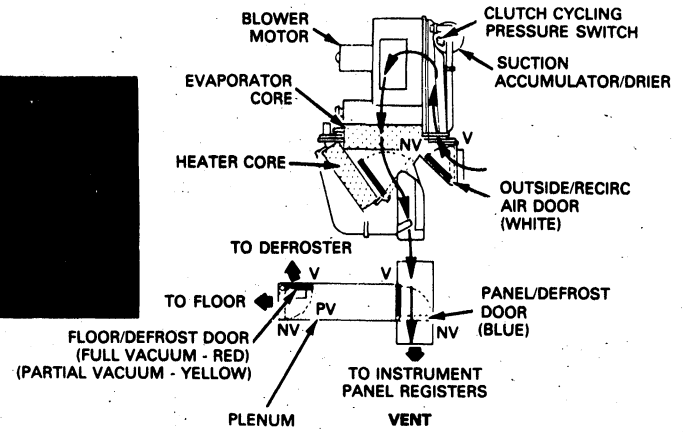
FLOOR POSITION



MIX POSITION



DEFROST POSITION



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FIG. 8 Airflow Diagram (VENT, FLOOR, MIX, DEFROST POSITIONS)

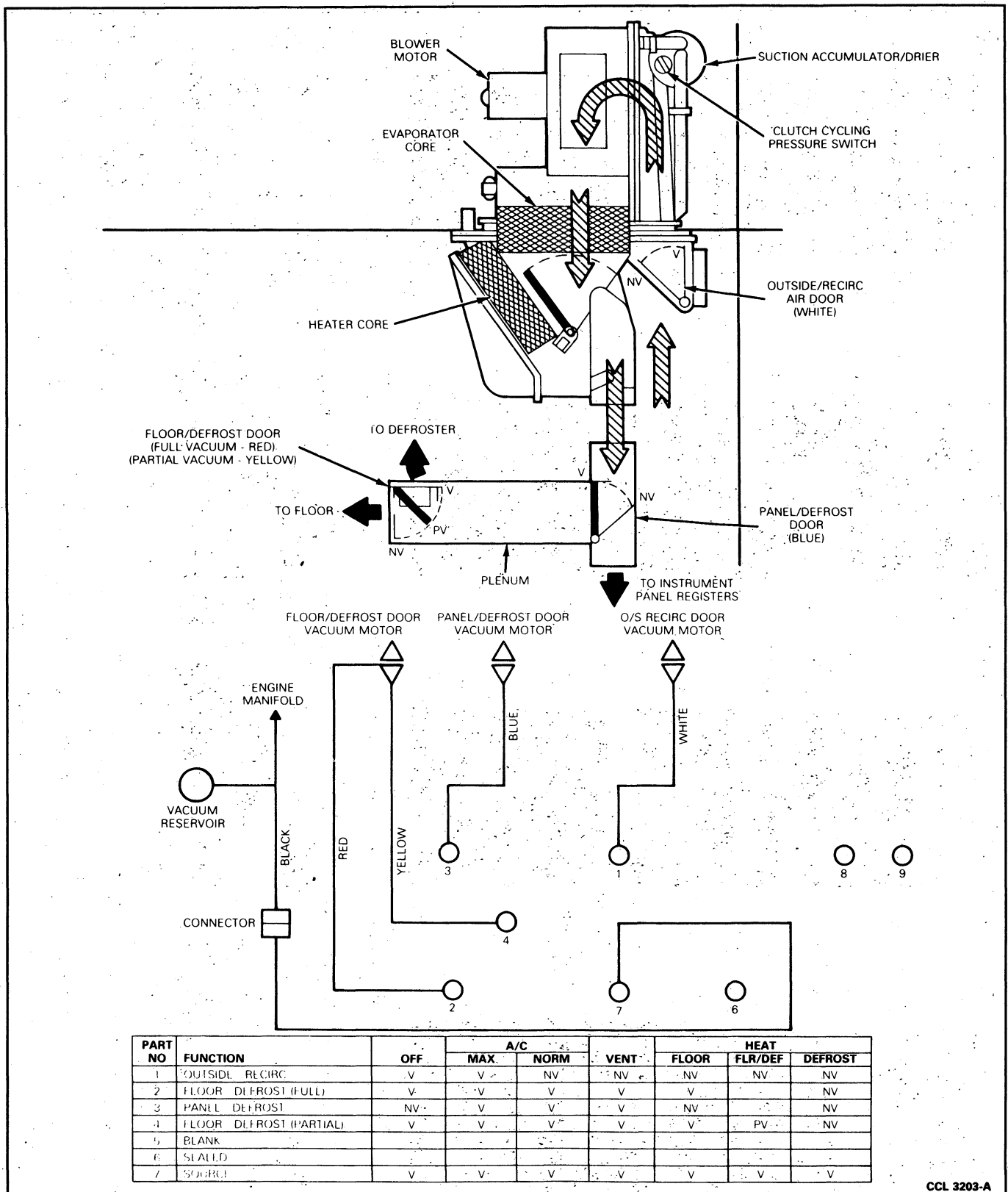


FIG. 9 Vacuum Circuit

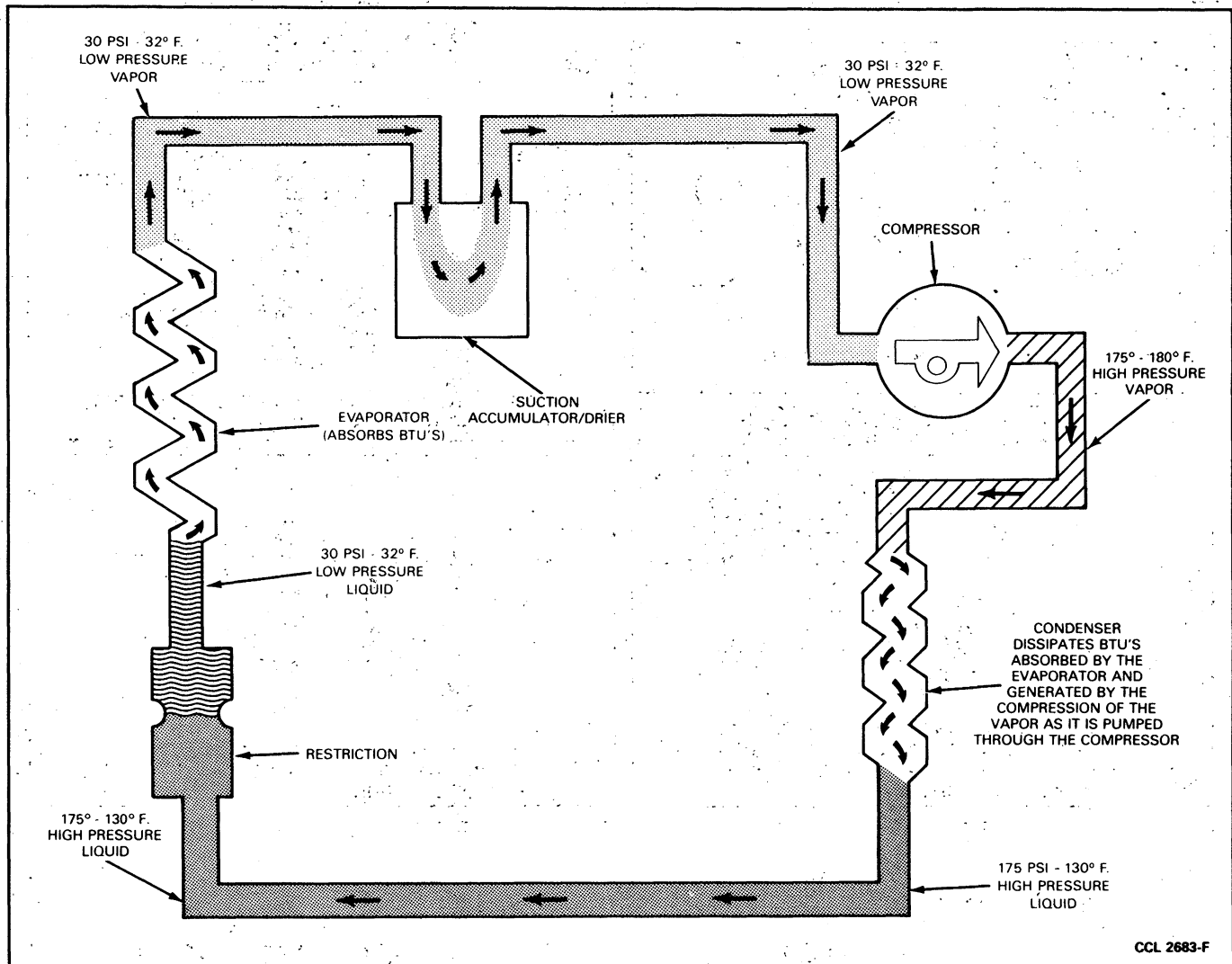


FIG. 10 Refrigeration Cycle

vacuum hose is probably pinched, kinked, disconnected or has a hole in it (Fig. 9).

### Refrigerant System

Diagnosis of refrigerant system performance must be done by analyzing the high and low pressure readings in the system. Compare the pressure readings to the chart shown in Fig. 13 to determine if the system pressures are normal. The conditional requirements for the refrigerant system tests must be satisfied to obtain accurate pressure readings.

NOTE: If conditional requirements are not satisfied, a normal system may appear to be functioning improperly. If they cannot be satisfied, pressure readings although inaccurate may be used to help determine the cause of a system problem.

Compare the pressure results with the conditions described in the pressure evaluation chart shown in Fig. 14.

Once the problem is corrected, take additional pressure readings while meeting the conditional requirements for the pressure tests to be sure that the problem has been corrected.

The low-pressure service access standard gauge port is located on the suction line under the center of the

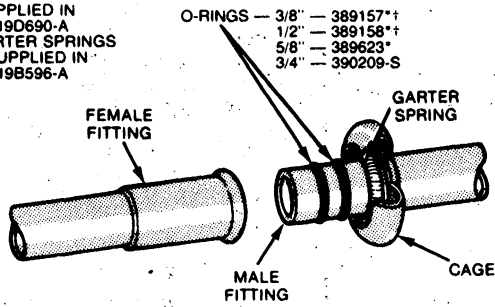
cowl. A special Service Access Adapter D81L-19703-A or Motorcraft Tools YT-354 or 355 are necessary to connect a manifold gauge set to the high pressure service access gauge port valve (Fig. 15). The adapters contain a Schrader-type valve core to prevent accidental discharge of refrigerant if the service hose is inadvertently disconnected from the adapter. Refer to Section 36-30, Air Conditioning-General Service for details regarding refrigerant system service and for procedures describing the use of the Special Tee Adapter Tool D87P-19703-A.

NOTE: Whenever a refrigerant line is replaced, or service for a major component requires the opening of the system to the atmosphere, the suction accumulator/drier must be replaced.

### Excess Moisture

One of the characteristics of an air conditioner is that it will remove moisture from air passing through the cooled evaporator core. This moisture (condensate) then runs off the evaporator core and is drained from the evaporator case. In some instances, leaves or other foreign material plug the drain and sometimes mechanical conditions such as a damaged drain tube prevent the condensate from draining from the evaporator case. If either of these conditions exist,

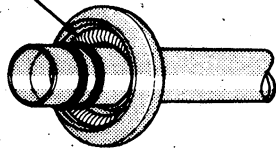
\*ALSO SUPPLIED IN  
KIT E35Y-19D690-A  
WITH GARTER SPRINGS  
\* ALSO SUPPLIED IN  
KIT E1ZZ-19B596-A



SPRING LOCK COUPLING DISCONNECTED

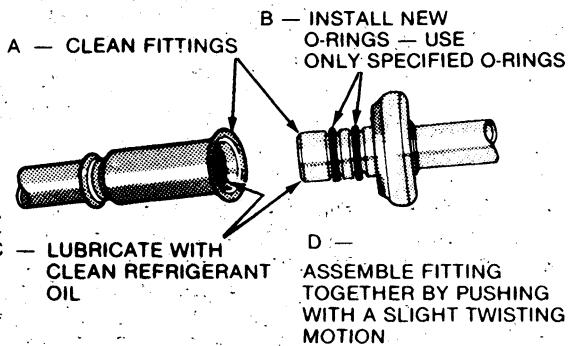
### TO CONNECT COUPLING

GARTER  
SPRING



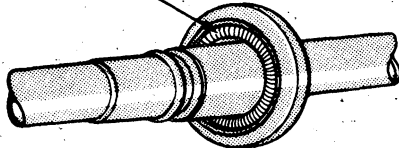
1 CHECK FOR MISSING OR DAMAGED GARTER SPRING — REMOVE DAMAGED SPRING WITH SMALL HOOKED WIRE — INSTALL NEW SPRING IF DAMAGED OR MISSING.

REPLACEMENT GARTER SPRINGS  
3/8 INCH — E1ZZ-19E576-A\*  
1/2 INCH — E1ZZ-19E576-B\*  
5/8 INCH — E35Y-19E576-A\*  
3/4 INCH — E69Z-19E576-A\*  
\*ALSO AVAILABLE IN  
E35Y-19D690-A KIT WITH O-RINGS



2

GARTER SPRING

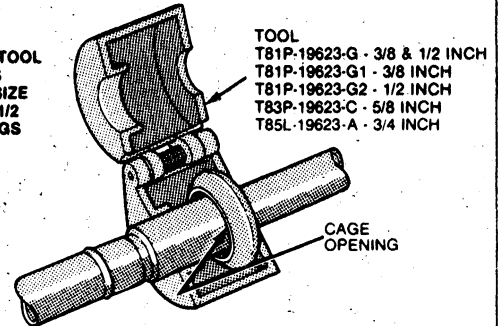


3 TO ENSURE COUPLING ENGAGEMENT, VISUALLY CHECK TO BE SURE GARTER SPRING IS OVER FLARED END OF FEMALE FITTING.

### TO DISCONNECT COUPLING

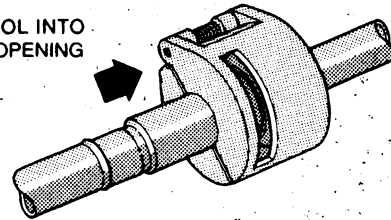
CAUTION — DISCHARGE SYSTEM BEFORE DISCONNECTING COUPLING

NOTE:  
EACH END OF TOOL  
T81P-19623-G IS  
A DIFFERENT SIZE  
TO FIT 3/8 and 1/2  
INCH COUPLINGS

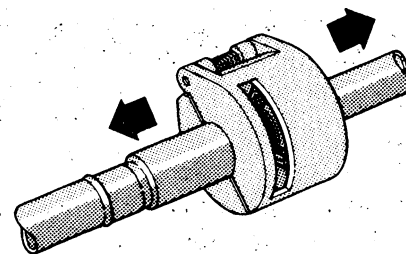


1 FIT TOOL TO COUPLING SO THAT TOOL CAN ENTER CAGE OPENING TO RELEASE THE GARTER SPRING.

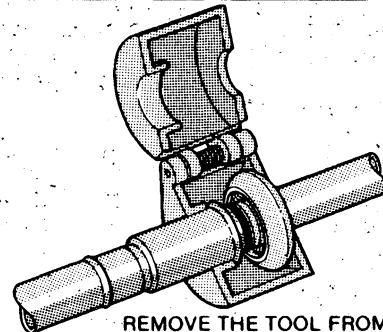
PUSH TOOL INTO  
CAGE OPENING



2 PUSH THE TOOL INTO THE CAGE OPENING TO RELEASE THE FEMALE FITTING FROM THE GARTER SPRING.



3 PULL THE COUPLING MALE AND FEMALE FITTINGS APART.



4 REMOVE THE TOOL FROM THE DISCONNECTED SPRING LOCK COUPLING.

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FIG. 11 Spring Lock Coupling



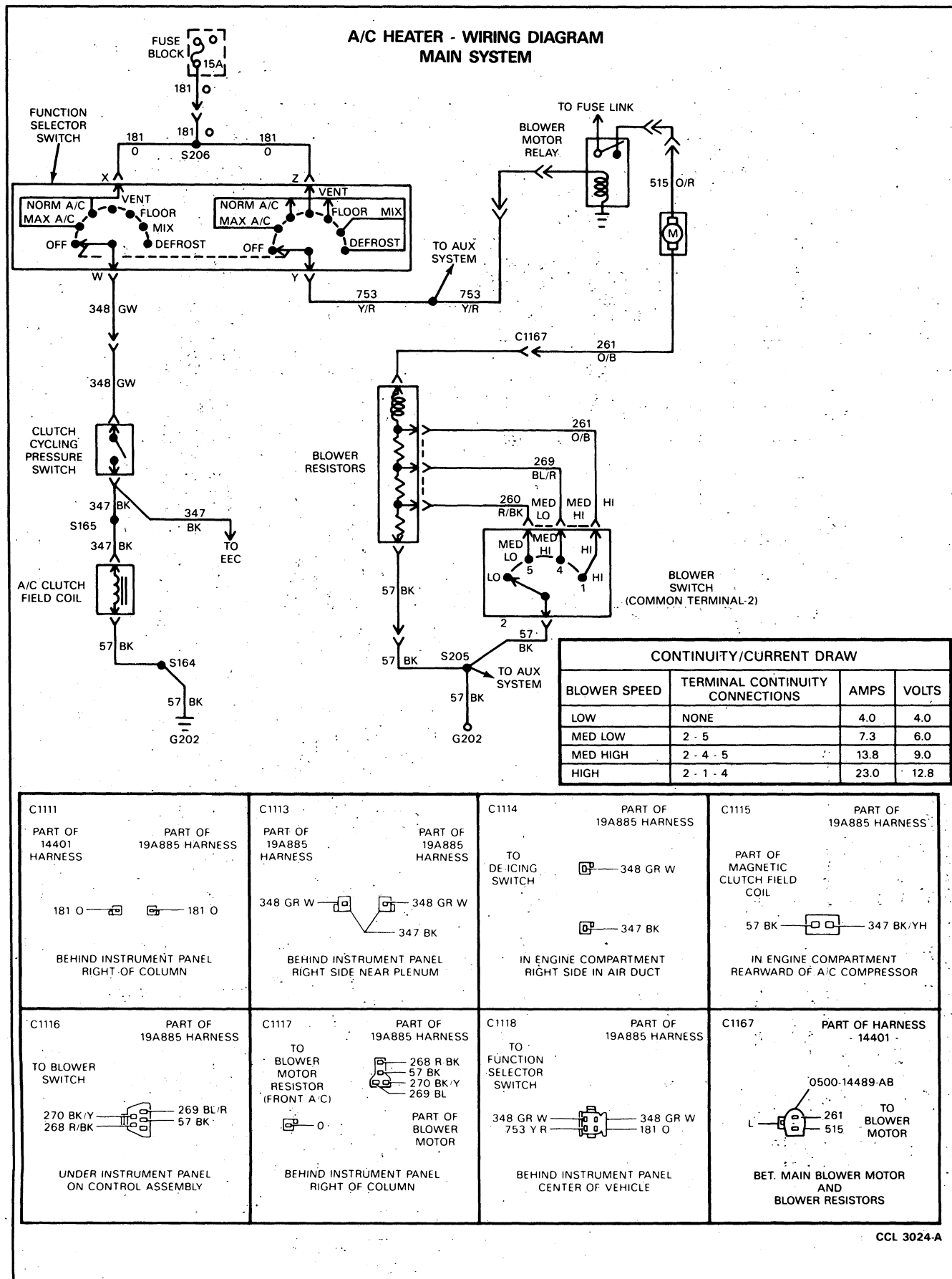
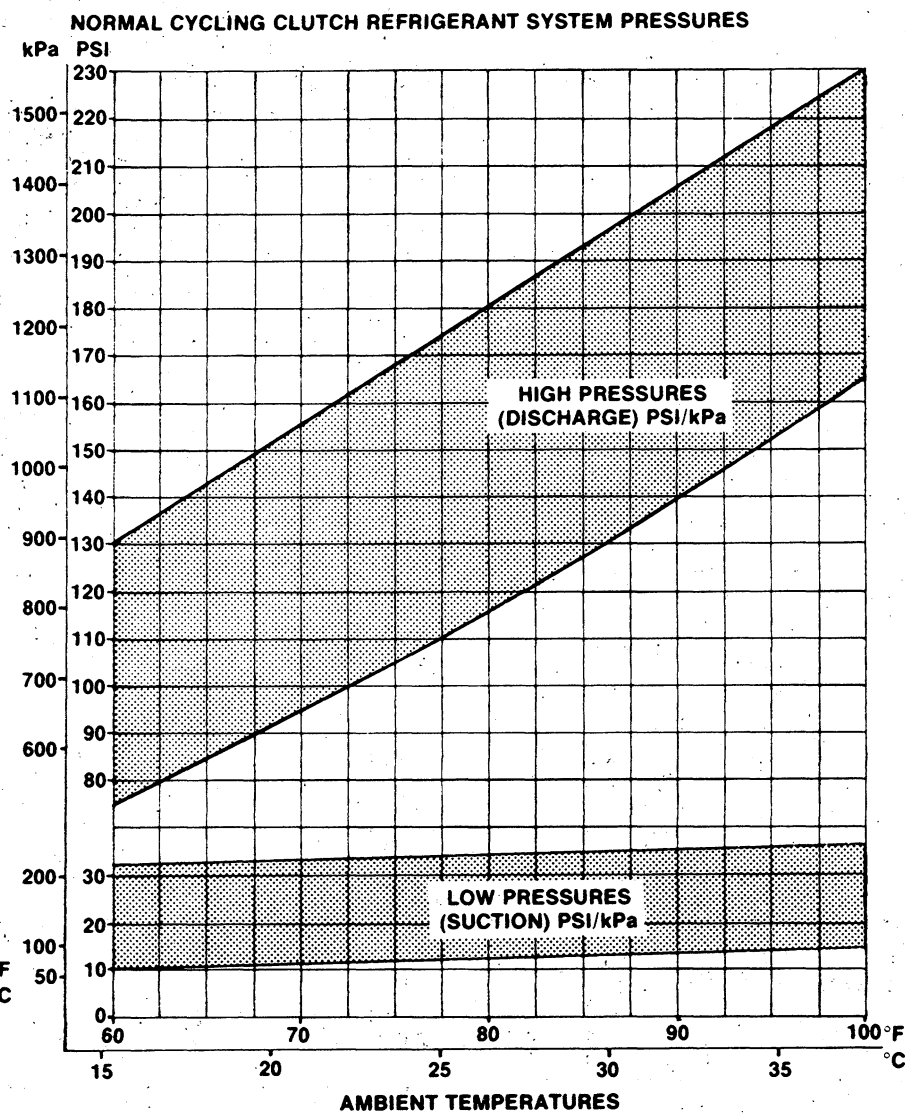
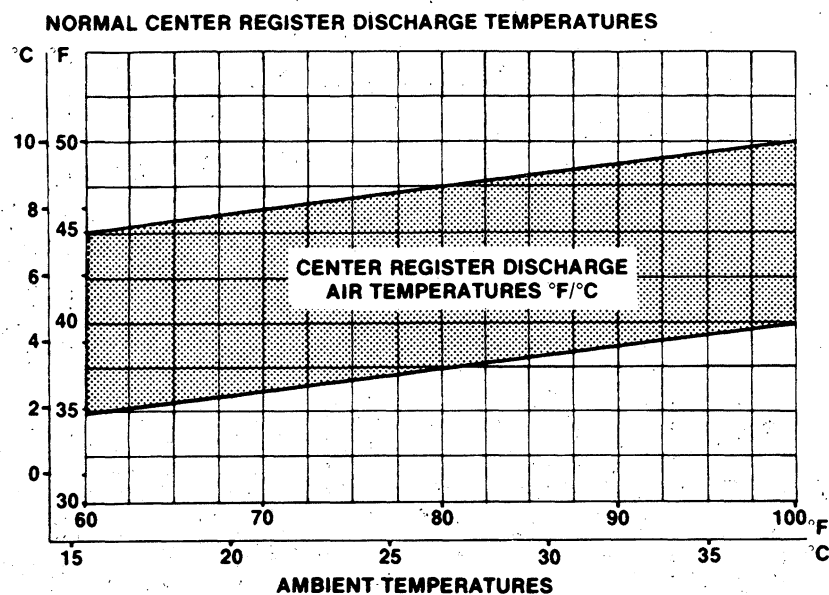


FIG. 12 Manual A/C Heater Wiring Diagram

THESE CONDITIONAL REQUIREMENTS FOR THE CYCLING CLUTCH SYSTEM TESTS MUST BE SATISFIED TO OBTAIN ACCURATE PRESSURE READINGS.

- Stabilized Pressures
- Stabilized in Car Temperatures (at 70° to 80°F (21° to 27°C))
- Maximum A/C (Recirculating Air)
- Maximum Blower Speed
- 1500 Engine RPM
- Compressor Clutch Engaged



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FIG. 13 Normal Clutch Cycling Pressure/Temperature Relationship

## REFRIGERANT SYSTEM PRESSURE AND CLUTCH CYCLE TIMING EVALUATION CHART FOR FIXED ORIFICE TUBE CYCLING CLUTCH SYSTEMS

NOTE: System test requirements must be met to obtain accurate test readings for evaluation. Refer to the normal refrigerant system pressure/temperature and the normal clutch cycle ratio and times charts.

High (Discharge) Pressure	Low (Suction) Pressure	Clutch Cycle Time			Component — Causes
		Rate	On	Off	
High	High	Continuous Run			Condenser — Inadequate Airflow
High	Normal to High				Engine Overheating
Normal to High	Normal				Air in Refrigerant Refrigerant Overcharge (a) Humidity or Ambient Temp Very High (b)
Normal	High				Fixed Orifice Tube — Missing O Rings Leaking/Missing
Normal	High	Slow	Long	Long	Clutch Cycling Switch — High Cut In
Normal	Normal	Slow or No Cycle	Long or Continuous	Normal or No Cycle	Moisture in Refrigerant System Excessive Refrigerant Oil
		Fast	Short	Short	Clutch Cycling Switch — Low Cut In or High Cut Out
Normal	Low	Slow	Long	Long	Clutch Cycling Switch — Low Cut Out
Normal to Low	High	Continuous Run			Compressor — Low Performance
Normal to Low	Normal to High				A/C Suction Line — Partially Restricted or Plugged (c)
Normal to Low	Normal	Fast	Short	Normal	Evaporator — Restricted Airflow
			Short to Very Short	Normal to Long	Condenser fixed orifice Tube or A/C Liquid Line — Partially Restricted or Plugged
			Short to Very Short	Short to Very Short	Low Refrigerant Charge
			Short to Very Short	Long	Evaporator Core — Partially Restricted or Plugged
Normal to Low	Low	Continuous Run			A/C Suction Line — Partially Restricted or Plugged (d) Clutch Cycling Switch — Sticking Closed
Low	Normal	Very Fast	Very Short	Very Short	Clutch Cycling Switch — Cycling Range Too Close
Erratic Operation or Compressor Not Running		—	—	—	Clutch Cycling Switch — Dirty Contacts or Sticking Open Poor Connection at A/C Clutch Connector or Clutch Cycling Switch Connector A/C Electrical Circuit Erratic — See A/C Electrical Circuit Wiring Diagram
Additional Possible Cause Components Associated with Inadequate Compressor Operation					
<ul style="list-style-type: none"> <li>• Compressor Drive Belt — Loose</li> <li>• Compressor Clutch — Slipping</li> <li>• Clutch Coil Open — Shorted or Loose Mounting</li> <li>• Control Assembly Switch — Dirty Contacts or Sticking Open</li> <li>• Clutch Wiring Circuit — High Resistance Open or Blown Fuse</li> </ul>					
Additional Possible Cause Components Associated with a Damaged Compressor					
<ul style="list-style-type: none"> <li>• Compressor Clutch — Seized</li> <li>• Clutch Cycling Switch — Sticking Closed</li> <li>• Suction Accumulator Drier — Refrigerant Oil Bleed Hole Plugged</li> <li>• Refrigerant Leaks</li> </ul>					
(a) Compressor may make noise on initial run. This is slugging condition caused by excessive liquid refrigerant.					
(b) Compressor clutch may not cycle in ambient temperatures above 80°F depending on humidity conditions.					
(c) Low pressure reading will be normal to high if pressure is taken at accumulator and if restriction is downstream of service access valve.					
(d) Low pressure reading will be low if pressure is taken near the compressor and restriction is upstream of service access valve.					

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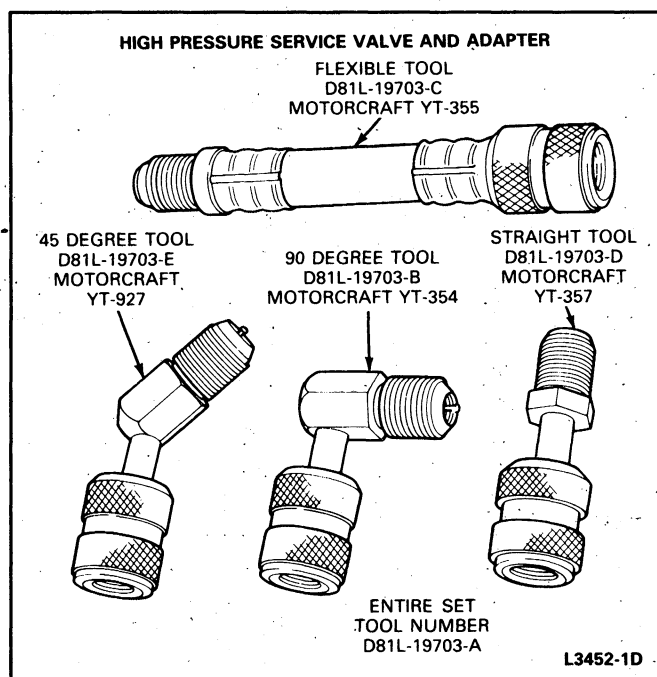
FIG. 14 Refrigerant System Pressure Evaluation Chart

condensate may drip from the evaporator case or be blown from the instrument panel registers. This cause of insufficient evaporator case drainage can best be eliminated by performing the inspection and correction procedure which as follows.

1. Inspect the vehicle dash panel for missing grommets plugs or seals. Also, inspect for correct

sealing of the evaporator case-to-dash panel retaining nuts to correct a seal leak between the evaporator case and the dash panel.

2. Inspect for possible air leaks around the heater lines at the evaporator case and around the electrical connector at the bottom of the evaporator case. Seal any leaks around the



**FIG. 15 High Pressure Service Access Gauge Port Valve**

refrigerant lines with insulating Tape Motorcraft YZ-1, or Caulking Cord D6AZ-19560-A, or equivalent.

## ADJUSTMENTS

### Temperature Control Cable

1. Set the temperature control lever in the COOL position.
2. Remove the cable from the retaining clip on top of the evaporator-heater core. Leave the cable attached to the yellow crank.
3. Rotate the yellow crank counterclockwise until the temperature blend door seats.
4. Check again to be sure that the temperature lever is in the COOL position. Then, install the cable housing in its retaining clip by pushing it from the top until it snaps into place.
5. Turn the blower switch to its HI position and move the temperature lever through its range of travel to check for proper cable adjustment. Readjust if necessary.

## REMOVAL AND INSTALLATION

### Control Assembly

#### Removal

1. Remove trim applique.
2. Remove four screws retaining control assembly to mounting bracket (Fig. 16).
3. Carefully pull control assembly from opening in mounting bracket.
4. Disconnect electrical wiring connector from blower switch, vacuum selector, and illumination bulb.
5. Remove push-on vacuum harness retaining clips from vacuum selector.

6. Disconnect vacuum harness from vacuum selector.
7. Remove temperature control cable from control assembly. Disconnect bullet-type cable retainer from the bracket using the Control Cable Removal Tool T83P-18532-AH (Fig. 17) or needlenose pliers to compress the retaining ears. Both cable "S" bends are removed from the bottom side of the levers by rotating cable wire 90 degrees to the lever.

#### Installation

1. Connect temperature and function control cables to the control assembly (Fig. 17).
2. Connect vacuum harness to vacuum selector and retain it with two push-on clips.
3. Connect electrical wiring connector to blower switch(s), vacuum selector valve and illumination bulb wire and socket assembly.
4. Carefully position the control assembly on its mounting bracket and install attaching screws.
5. Install applique.
6. Adjust control cable as described previously.

### Blower Switch

#### Removal

1. Remove knob from blower switch (Fig. 16).
2. Remove trim applique.
3. Remove four screws retaining control assembly mounting bracket to instrument panel.
4. Carefully remove mounting bracket and control assembly from opening in instrument panel.
5. To remove blower switch, disconnect wire harness connector from blower switch and remove switch mounting bracket from control assembly (one screw).

#### Installation

1. Position blower switch and bracket on control assembly and secure with one screw.
2. Connect wiring harness to blower switch.
3. Position control assembly and bracket in instrument panel and secure it with four retaining screws.
4. Install trim applique.
5. Install knob(s) on switch.

### Vacuum Selector Valve

#### Removal

1. Remove instrument panel trim panel.
2. Remove four screws retaining control assembly mounting bracket to instrument panel.
3. Carefully remove mounting bracket and control assembly from opening in instrument panel.
4. Disconnect wire harness connector from vacuum selector valve.
5. Remove two push-on vacuum harness retainer clips from vacuum selector and disconnect harness from valve.
6. Remove two screws retaining vacuum selector valve to control assembly (Fig. 16).

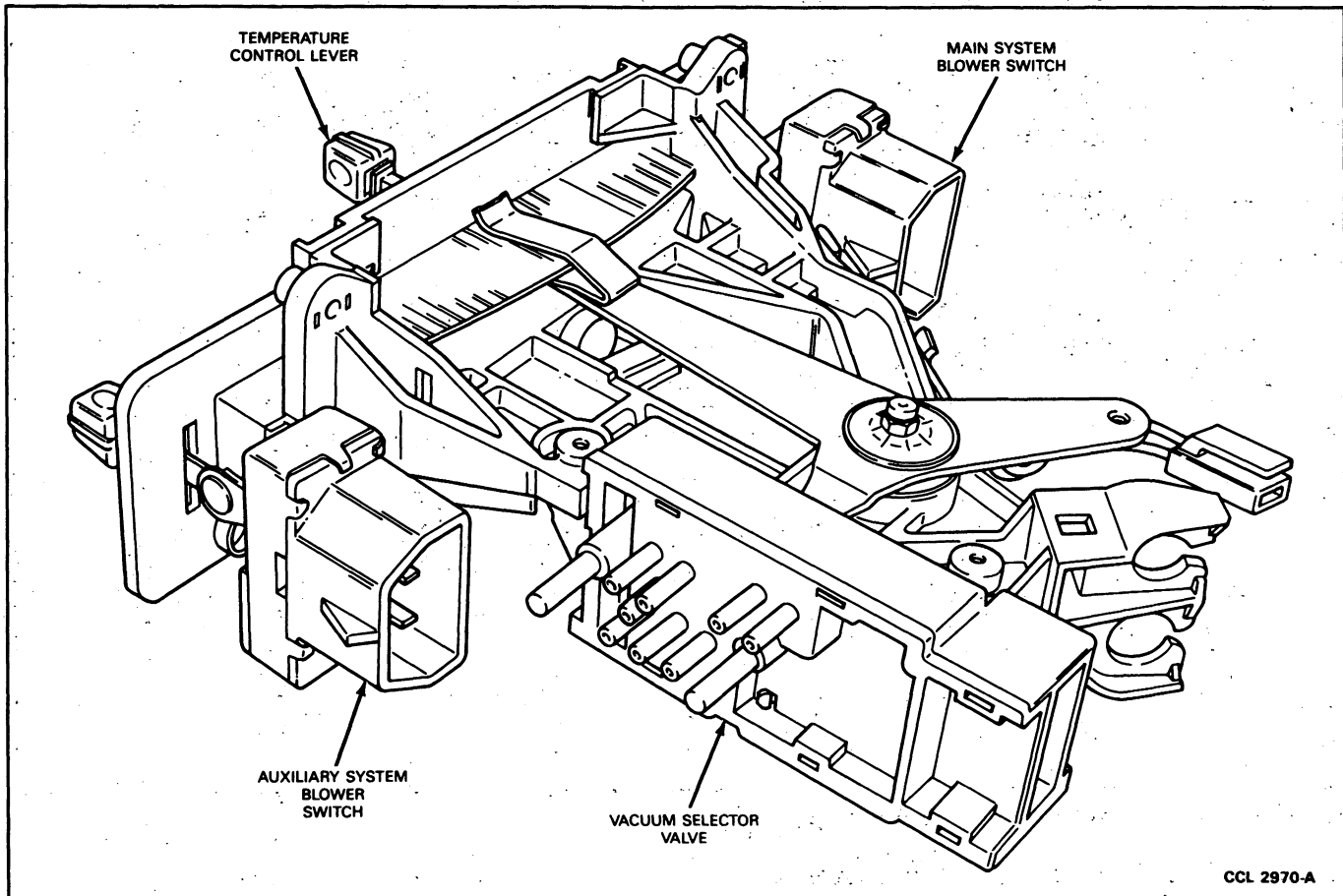


FIG. 16 Control Assembly

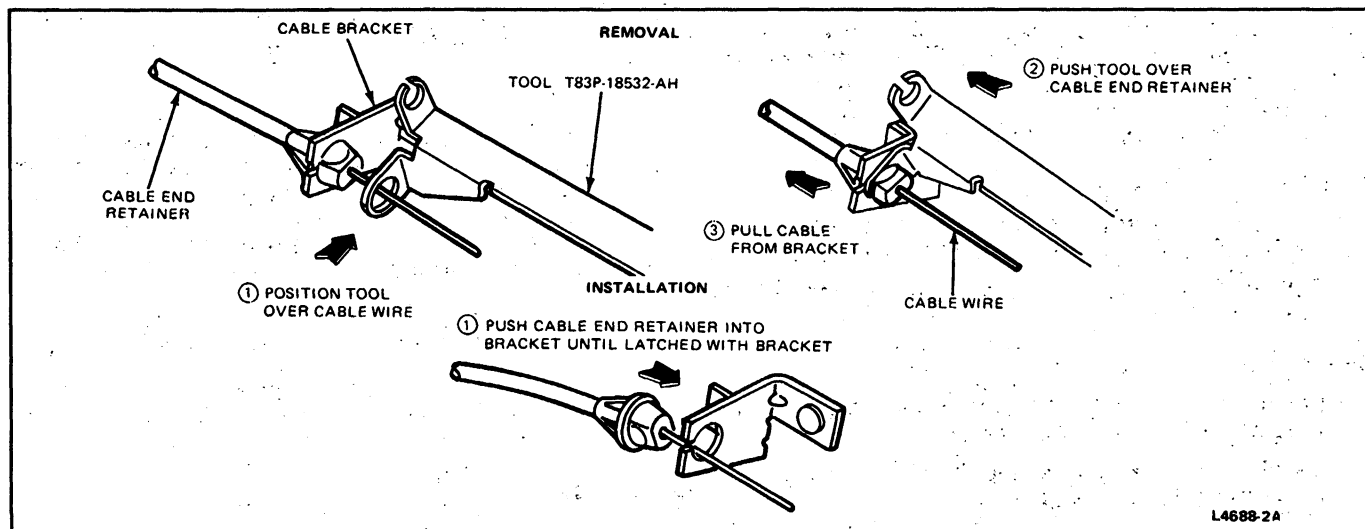


FIG. 17 Control Lever Cable Removal and Installation

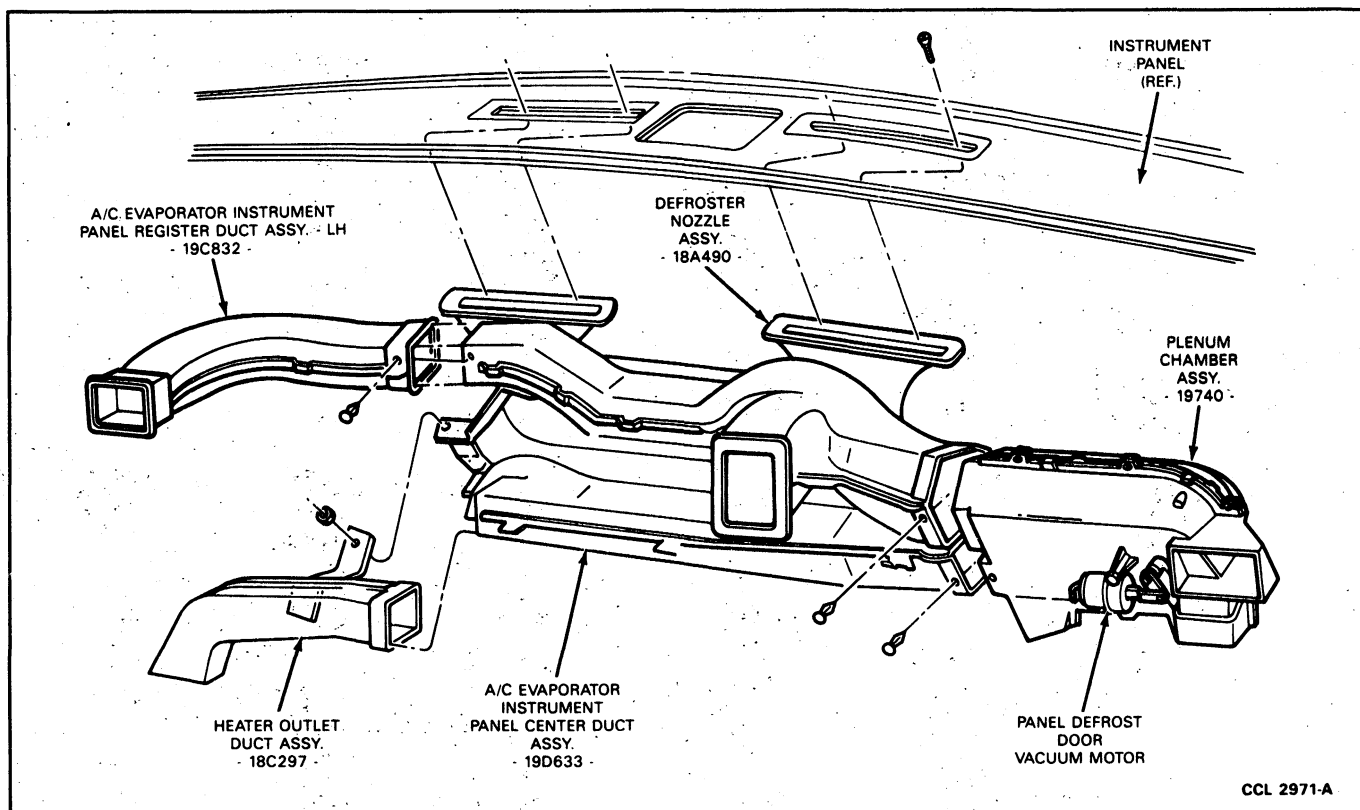
**Installation**

1. Position temperature lever at LH side of slot and function selector lever approximately 9.5mm (3/8 inch) from LH side of slot.
2. Position vacuum selector valve on control assembly, engaging selector lever arms with selector valve. Install two retaining screws.
3. Connect vacuum harness to selector valve and install two pushnuts.

4. Connect wire harness connector to selector.
5. Position control assembly and bracket in instrument panel and install four retaining screws.
6. Install instrument panel trim panel.

**Instrument Panel**

Removal and installation of several components and assemblies described in this Section require the removal and installation of the instrument panel. For



**FIG. 18 A/C—Heater Ducts and Defroster Nozzle**

instructions and illustrations, refer to Section 45-61, Instrument Panel and Pad.

### Defroster Nozzle

To remove the defroster nozzle, it is first necessary to remove the instrument panel, heater ducts and register ducts. Refer to Figure 18 for heater and register duct illustrations. Refer to Section 45-61, Instrument Panel and Pad for instrument panel removal and installation.

#### Removal

1. Remove two screws retaining defroster nozzle to each defroster opening near the windshield.
2. Pull defroster nozzle from plenum and remove it from vehicle.

#### Installation

1. Position defroster nozzle on plenum and align it with defroster openings.
2. Install two screws retaining defroster nozzle to each defroster opening.
3. Install register ducts and heater ducts following procedures described in this Section.
4. Install instrument panel. Refer to Section 45-61, Instrument Panel and Pad.
5. Check system for proper operation.

### Register Louver Assembly

#### Removal

1. Insert a thin-blade screwdriver under retaining tab (Fig. 19) and pry retaining tab toward louvers until retaining tab clears hole in register assembly.

2. Pull louver end out from register opening only enough to prevent louver pivot from going back into the pivot hole.
3. Repeat Step 1 for the other retaining tab and pull louver assembly from register opening.

#### Installation

The pivots on each end of some louver assemblies are different diameters and therefore determine the installed position. Other louvers have an arm extending inward on one end of the louver assembly. This end of the louver should be installed in the register assembly at the same end as the raised boss in the register assembly.

1. Position louver assembly into register opening.
2. Depress retaining tabs and push louver assembly into register opening and engage retaining tabs in pivot holes.

#### Registers

Refer to Figures 20, 21 and 22.

### Right Register Assembly

#### Removal

1. Remove louver assembly from register assembly.
2. Using a thin-blade screwdriver or an awl, pry the register assembly retaining tabs toward the register opening. Push the adapter retaining tabs out of the LH and RH sides of the register housing. Then, pull the register from the instrument panel opening and the register duct (Fig. 20).

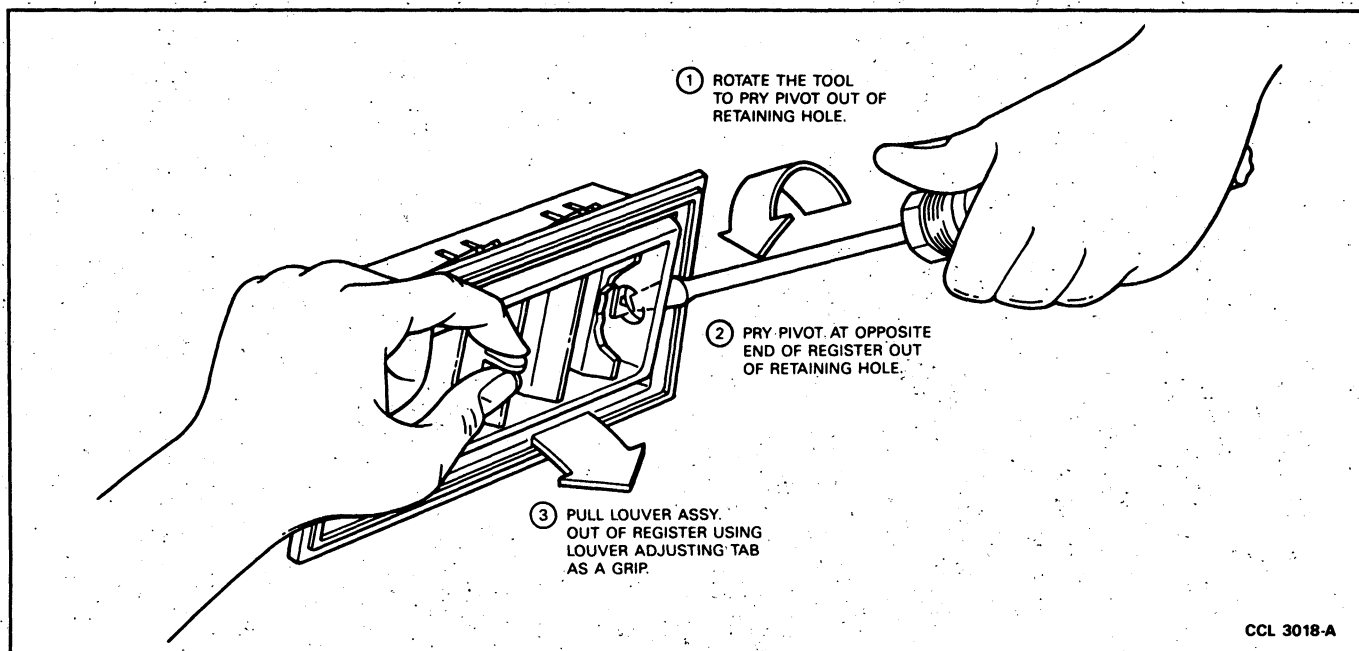


FIG. 19 Register Louver Removal

**Installation**

1. Position the register assembly into instrument panel opening. The correctly installed position is when the louvers are moved to the right to close.
2. While supporting the register adapter, push the register assembly into the instrument panel opening and the register duct until the register tabs lock into place behind the instrument panel opening flange and into the adapter.

**Center Register Panel Assembly**

1. Disconnect battery ground cable.
2. Remove control knobs from radio shafts, if so equipped.
3. Disconnect wire from cigar lighter, if so equipped.
4. Unsnap name plate from its recessed location at the right of registers, if so equipped.
5. Remove six screws (five without nameplate) retaining register panel assembly to instrument panel (Fig. 21).
6. Pull register panel assembly from instrument panel, unsnapping two clips at the right end of register panel.

**Installation**

1. Position register panel assembly to instrument panel and engage two snap clips.
2. Install register panel assembly attaching screws.
3. Install nameplate, if so equipped.
4. Connect wire to the cigar lighter, if so equipped.
5. Install control knobs on radio shafts, if so equipped.
6. Connect battery ground cable.

**Left Register Panel Assembly****Removal**

1. Disconnect battery ground cable.

2. Remove ignition lock cylinder and ignition switch bezel.
3. Remove headlamp switch knob and shaft. Then, remove headlamp switch bezel.
4. Remove knob from windshield wiper switch.
5. Remove two screws retaining LH register panel to the instrument panel (Fig. 22).
6. Pull register panel assembly away from instrument panel to disengage snap clips at top of register panel.

**Installation**

1. Position register panel in instrument panel and push it to engage snap clips.
2. Install two screws retaining lower edge of register panel to instrument panel.
3. Install headlamp switch bezel and knob and shaft assembly.
4. Install ignition switch bezel and ignition switch lock cylinder.
5. Install windshield wiper switch knob.
6. Connect battery ground cable.

**Air Ducts**

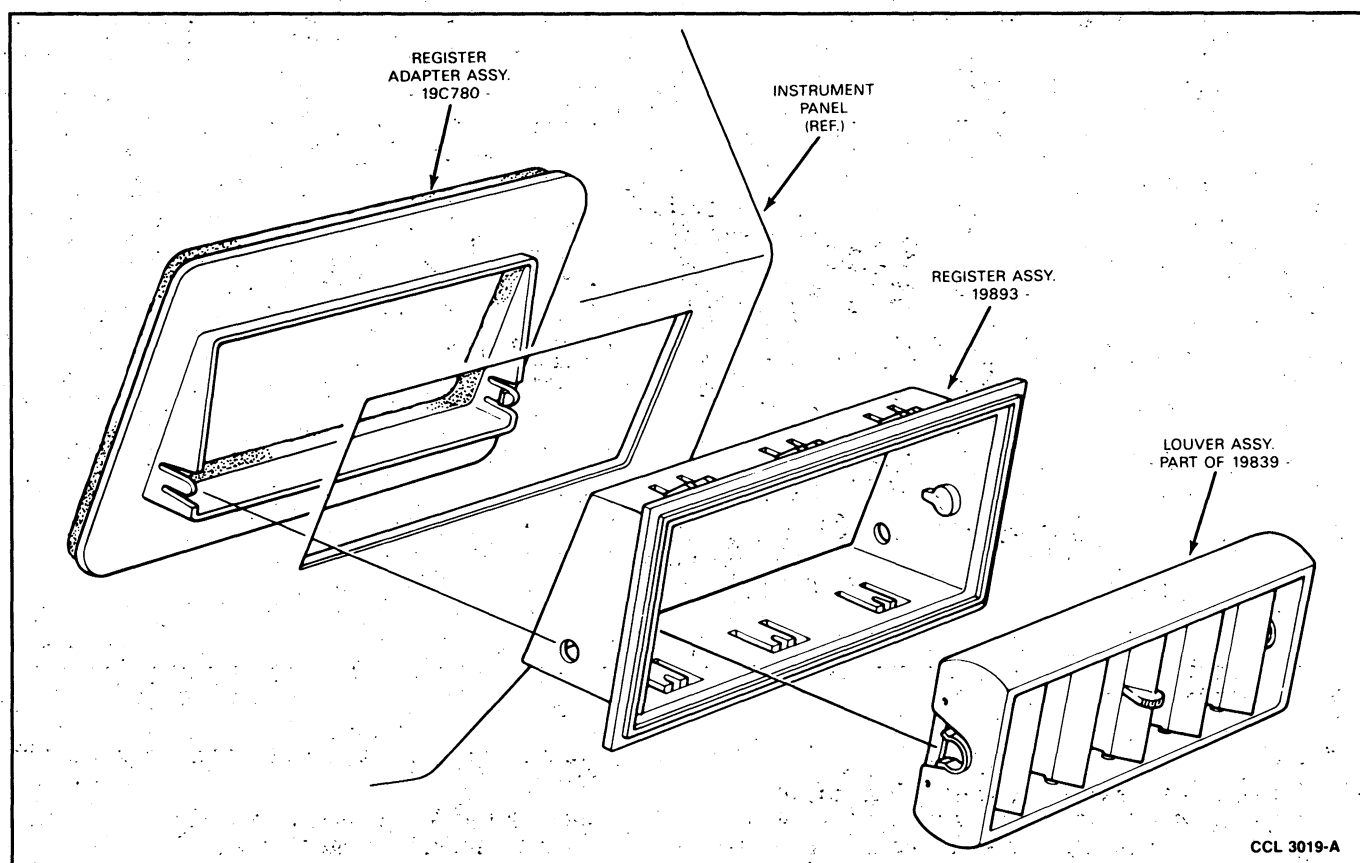
Remove instrument panel. Refer to Section 45-61, Instrument Panel and Pad. Refer to Fig. 18 for an illustration of the A/C-heater air ducts.

**Left Register Duct****Removal**

1. Remove retainer attaching LH register duct to center register duct (Fig. 18).
2. Pull LH register duct from center register duct.

**Installation**

1. Position LH register duct to center register duct and align retainer holes.



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**FIG. 20 Right Register Assembly**

2. Install retainer to attach LH register duct to center register duct.

**Center Register Duct****Removal**

1. Remove LH register duct.
2. Disengage vacuum harness locator tab from center register duct.
3. Remove one retainer attaching center register duct to plenum.
4. Remove one nut retaining heater air outlet duct, LH heat duct and center register duct support braces to brake pedal support (Fig. 18).
5. Disengage center register duct support brace from clip bolt and remove the center register duct.

**Installation**

1. Position the RH end of center register duct to plenum and support brace at LH end of duct to clip bolt.
2. Install LH heat duct support brace on clip bolt and install retaining nut.
3. Install retainer to attach center register duct to plenum (Fig. 18).
4. Connect vacuum harness locator tab to center register duct.
5. Install LH register duct.

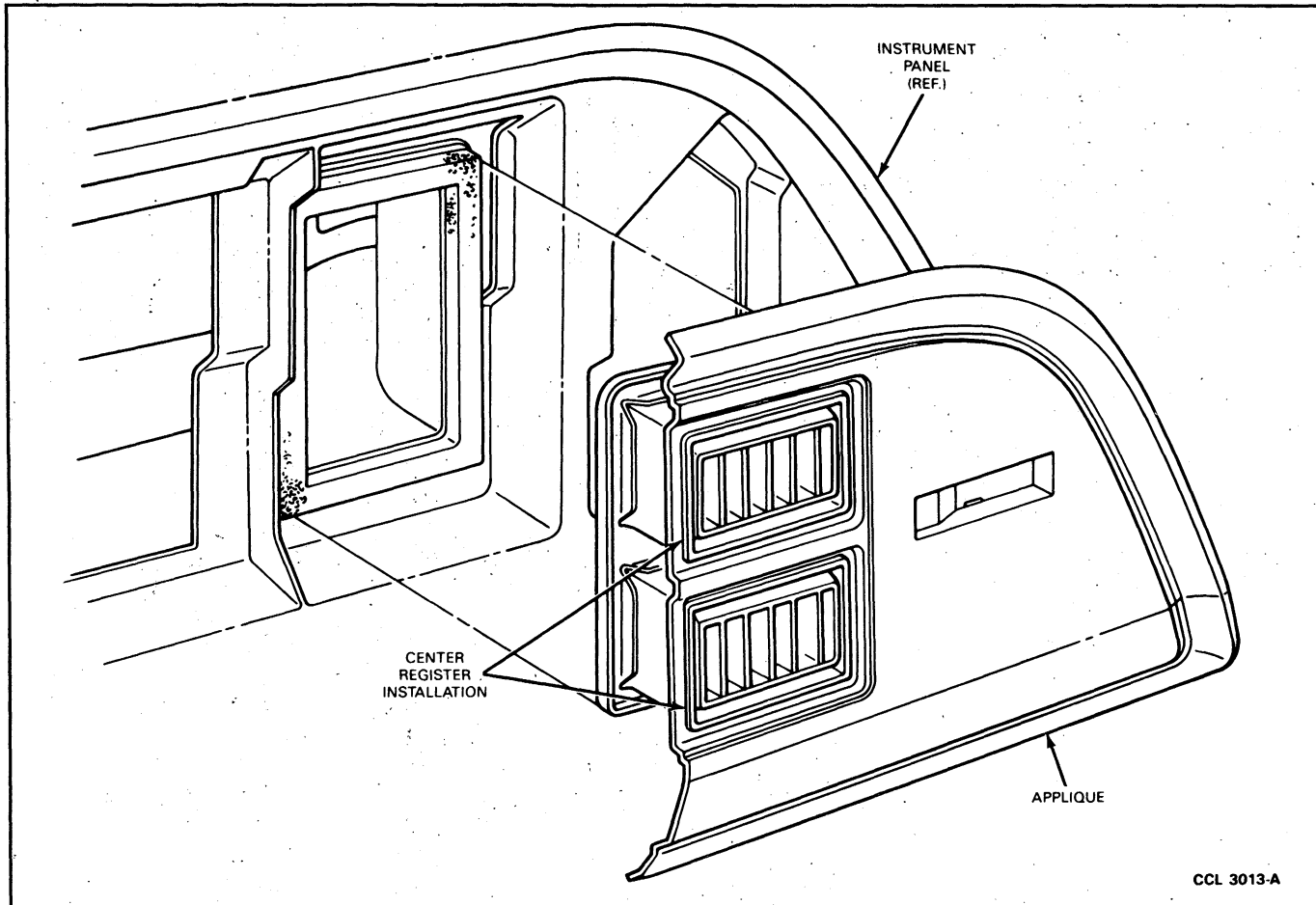
**Heater Duct****Removal**

1. Remove one nut retaining LH heat duct, floor outlet duct and center register duct support braces to brake pedal support braces to brake pedal support.
2. Disengage the wiring harness locator tabs and vacuum harness locator tab from heater air outlet duct.
3. Remove one retainer attaching LH heat duct to heater air outlet duct and remove LH heat duct.
4. Remove one retainer attaching heat duct to plenum (Fig. 18).
5. Disengage heater air outlet duct support brace from clip bolt on brake pedal support and remove heater air outlet duct.

**Installation**

1. Position RH end of heater air outlet duct to plenum and support brace at the LH end of the duct to clip bolt on brake pedal support.
2. Place center register duct support brace on clip bolt over heat duct brace.
3. Position LH heat duct to heater air outlet duct and support brace to clip bolt.
4. Install nut that retains three support braces to clip bolt (Fig. 18).
5. Install one retainer to attach heat duct to plenum and one retainer to attach LH heat duct to heater air outlet duct.





**FIG. 21 Center Register Assembly**

6. Install wiring harness and vacuum harness locator tabs in their respective locations on the heater air outlet duct.
7. Install instrument panel following the procedure in Section 45-61, Instrument Panel and Pad after all air ducts are installed.

#### Plenum Chamber

The plenum chamber is located under the instrument panel on top of the blower motor housing. For servicing the plenum-chamber, vacuum harness, and plenum doors, it is necessary to remove the instrument panel. It is not required to remove the instrument panel to service the vacuum motors attached to the plenum (Fig. 23).

#### Removal

1. Disconnect the vacuum hoses from the heat-defrost vacuum motor and the A/C-heat vacuum motor.
2. Remove one retainer attaching the center register duct to plenum and one retainer attaching heater air outlet duct to plenum.
3. Separate plenum from evaporator-heater housing, center register duct, and heater air outlet duct and remove plenum.

#### Installation

1. Install heat-defrost and A/C-heat door vacuum motors on plenum (Fig. 23).

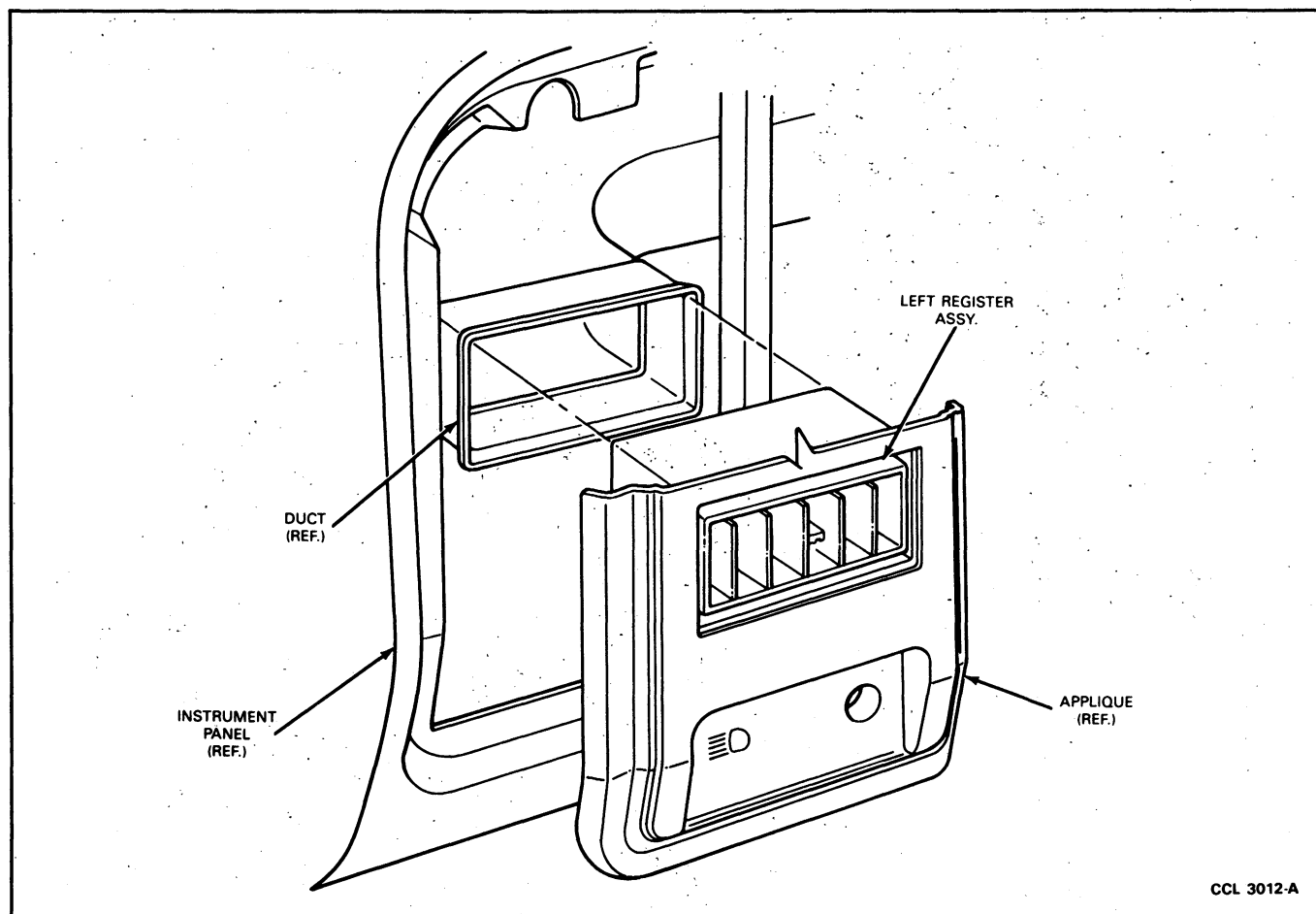
2. Position plenum to center register duct, heater air outlet duct and evaporator-heater housing. Ensure clip on plenum is hooked over flange on evaporator-heater housing.
3. Install one retainer to attach center register duct and one retainer to attach heater air outlet duct to plenum.
4. Connect the blue vacuum hose to the top (end) of the A/C-heat door vacuum motor.
5. Connect the yellow vacuum hose to the top (end) of the heat-defrost door vacuum motor. Connect the red vacuum hose to the side of the heat-defrost door vacuum motor.
6. Install the instrument panel. Refer to Section 45-61, Instrument Panel and Pad.
7. Check system for proper operation.

#### Outside/Recirculating Air Door Vacuum Motor

##### On Evaporator Case

#### Removal

1. Remove two screws retaining motor to evaporator-heater housing (Fig. 24).
2. Carefully pry vacuum motor arm off rosebud clip on door crank.
3. Disconnect the vacuum hose from outside-recirc vacuum motor and remove motor and bracket.



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**FIG. 22 Left Register Assembly****Installation**

1. Snap the vacuum motor arm over the rosebud clip on the crank.
2. Connect vacuum hose to vacuum motor and position the motor and bracket to the evaporator-heater case.
3. Install the two screws retaining vacuum motor.
4. If necessary, install a new pushnut (Part No. 383358-S) or equivalent to retain motor arm on door crank arm.
5. Check system for proper operation.

**Vacuum Motors****On Plenum**

Remove and install vacuum motors as shown in Fig. 25. The illustration also relates the vacuum harness to each vacuum motor.

**Clutch Cycling Pressure Switch**

The clutch cycling pressure switch is attached to the suction accumulator/drier located in the engine compartment (Fig. 26). In the A/C position, the pressure switch senses pressure in the drier and electrically controls the cycling of the clutch assembly to prevent the core from freezing the condensation which occurs. If allowed to build up, the ice would block airflow. The cut-in pressure of the compressor clutch is approximately

43.5 lbs (clutch is operative) and the cut-out pressure is approximately 24.5 lbs (clutch is inoperative).

**Removal**

1. Remove electrical connector from switch. Unscrew pressure switch from top of suction accumulator/drier.

**Installation**

1. Lubricate O-ring which is installed over switch threads. Use refrigerant oil.
2. Screw pressure switch onto top of suction accumulator/drier. Do not exceed specified torque limits. Tighten to 7-13 N·m (5-10 ft-lb). Install electrical connector.

**Blower Motor and Wheel Assembly****Removal**

1. Disconnect blower motor electrical connector (Fig. 27).
2. Remove four screws retaining blower motor mounting plate to the evaporator case assembly.
3. Remove motor and wheel assembly from evaporator case.
4. If old wheel is to be used on new motor, position it on the motor shaft so that distance from mounting to base of wheel is same as previous installation.

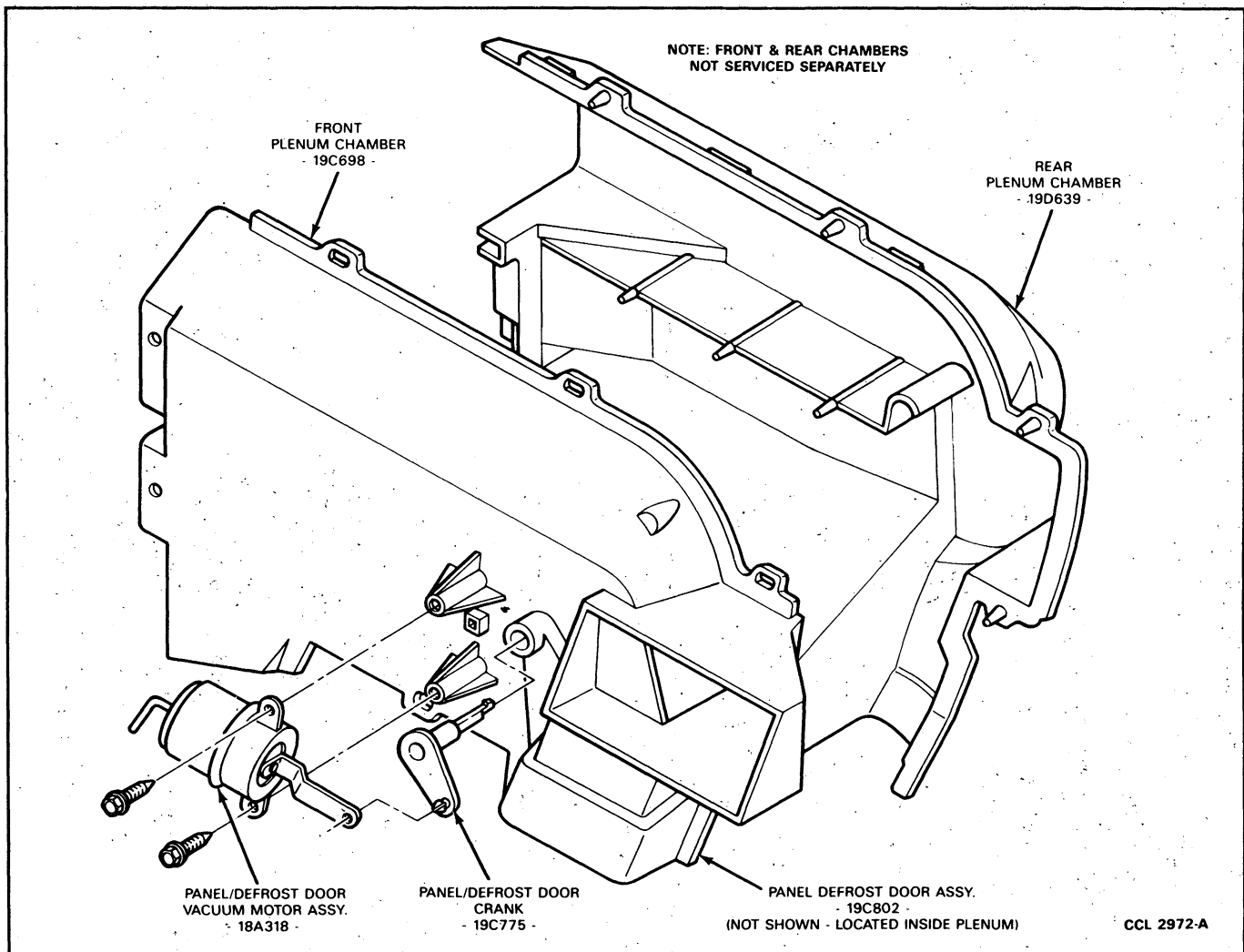


FIG. 23 Plenum Chamber

**Installation**

1. When wheel is properly installed on new motor, insert assembly into evaporator case and align locator pins with holes in base plate.
2. Install four mounting screws retaining motor mounting base plate.
3. Connect the electrical connector.
4. Check blower motor for proper operation.

**Resistor Assembly****Removal and Installation**

1. Disconnect electrical connector from resistor located on the evaporator case in the engine compartment. Refer to Figure 28.
2. Remove two screws from old resistor on front face of A/C blower evaporator-heater cover and remove resistor.
3. Install new resistor to evaporator-heater cover with two screws and connect electrical connector.

**Heater Core and Seal Assembly****Removal**

1. Remove inlet and outlet hoses from heater core in engine compartment. Plug hoses with a 15.875mm (5/8-inch) diameter plug.
2. Remove two screws retaining modesty panel to underside of instrument panel. Remove panel.
3. Remove the four screws from heater core cover located on the LH side of case underneath instrument panel (Fig. 29). Remove cover.
4. Remove screw and retaining bracket at bottom of heater core.
5. Remove heater core and seal from case (Fig. 30).

**Installation**

1. Position heater core and seal assembly and install core retaining brackets and screws.
2. Remove plugs from hoses.
3. Install inlet and outlet hoses to heater core.
4. Position heater cover and install four retaining screws.
5. Attach modesty panel to instrument panel with two retaining screws.

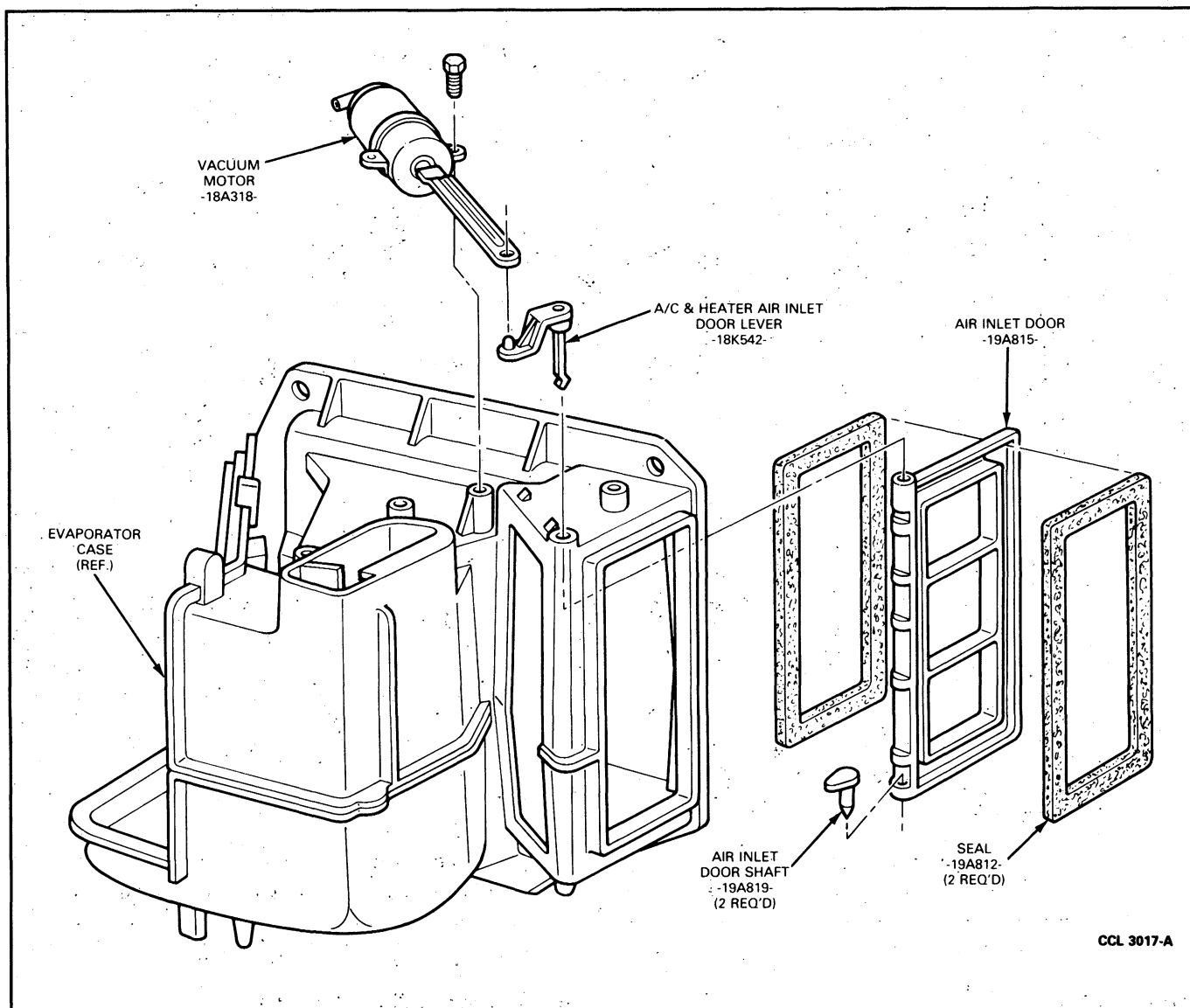


FIG. 24 Outside/Recirc Air Door Vacuum Motor

## Evaporator Core

### Removal

1. Disconnect electrical connector from resistor on evaporator case and from pressure switch on accumulator.
2. Disconnect battery cables and remove battery.
3. Disconnect EEC-IV harness.
4. Remove heater hoses from heater core and plug hoses with suitable 15.875mm (5/8-inch) plugs.
5. Discharge refrigerant from system observing all safety precautions.
6. Disconnect suction line from accumulator/drier and liquid line from evaporator core.
7. Remove five nuts retaining evaporator assembly to dash and remove evaporator assembly (Fig. 30).
8. Remove two screws retaining accumulator/drier to case.
9. Disconnect accumulator from evaporator case.
10. Remove evaporator core and seal assembly by pulling back retaining tab in housing.

### Installation

When installing the evaporator core and seal assembly, make sure all new O-ring seals are used and positioned properly in their respective location.

**CAUTION: Use care not to damage or bend fins when handling evaporator core.**

1. Position evaporator core and seal assembly on the evaporator assembly and snap it into the four retaining tabs.
2. Install accumulator/drier on evaporator core.
3. Install two screws which retain the accumulator to case.
4. Position evaporator assembly against the dash and secure with five nuts (Fig. 30).
5. Connect suction line to accumulator/drier and liquid line to evaporator core.
6. Connect EEC-IV harness.

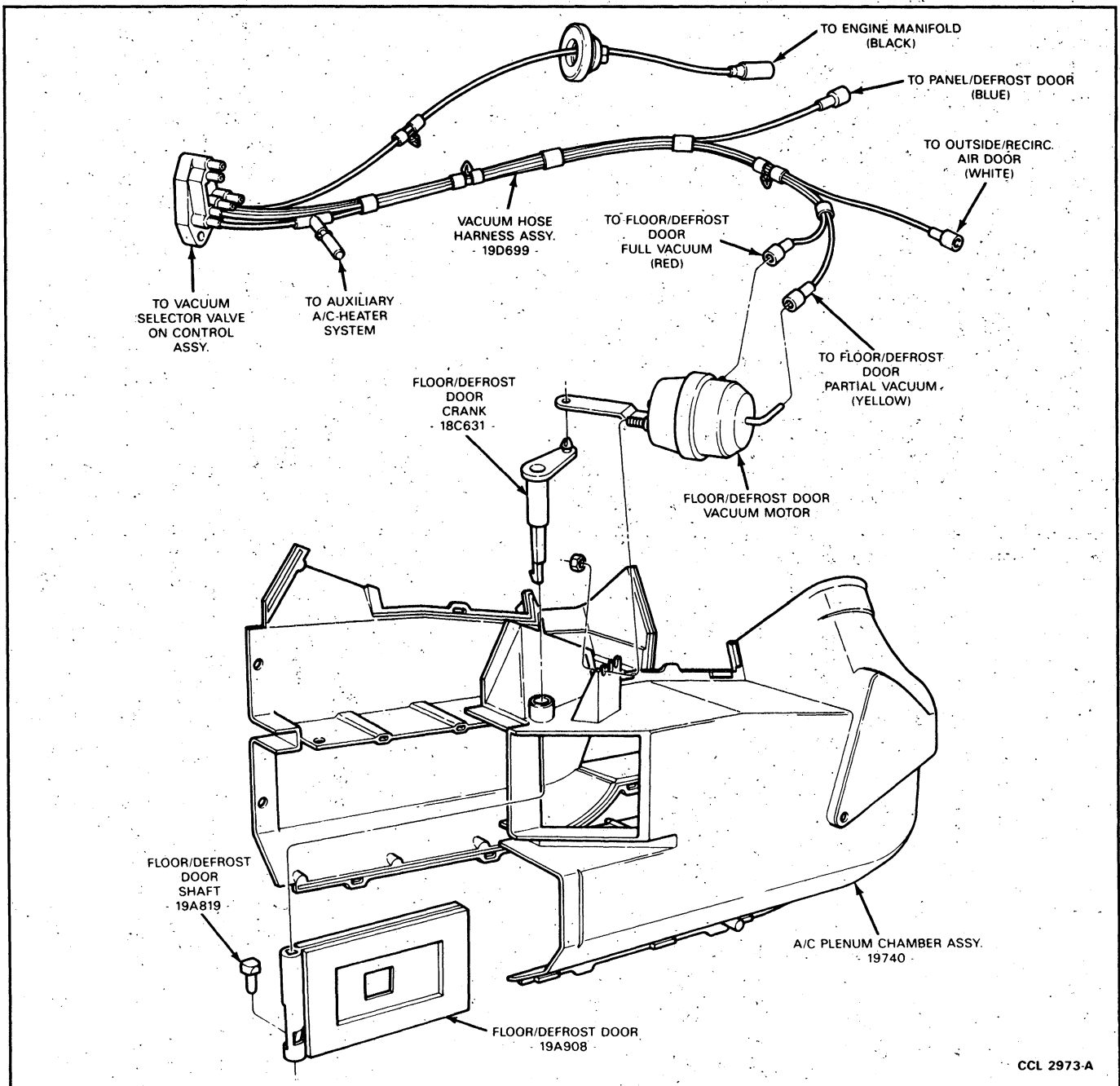


FIG. 25 Typical Vacuum Motor to Plenum Installation and Harness Assembly

7. Install battery and connect battery cables.
8. Install connectors to resistor and pressure switch.
9. Remove plugs from hoses.
10. Connect heater hoses to heater core.
11. Refill cooling system with coolant.
12. Charge A/C system and check it for leaks.

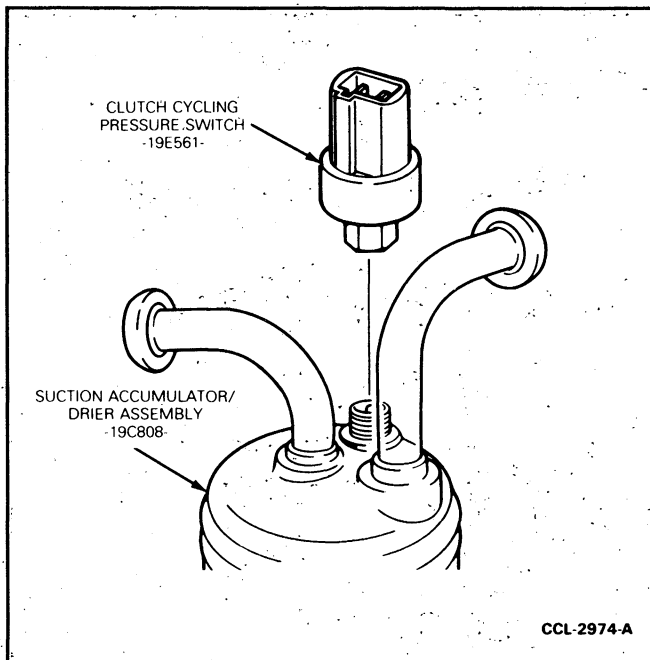
#### Fixed Orifice Tube

The fixed orifice tube is constructed with a plastic body, two screens and a small brass tube down the center of the orifice body. Two O-rings are around the orifice tube body to seal against leakage around the body (Fig. 31).

**CAUTION:** Do not attempt to remove the fixed orifice tube with pliers or by twisting tube. To do so will break the fixed orifice tube body in the evaporator core tube. Use only the recommended tool and follow the recommended service procedures.

#### Removal

1. Discharge refrigerant from A/C system. **Observe all safety precautions.**
2. Disconnect liquid line from evaporator core. Cap liquid line to prevent entry of dirt and excessive moisture.
3. Squirt a small amount of clean refrigerant oil into evaporator core inlet tube to lubricate tube and



**FIG. 26 Clutch Cycling Pressure Switch**

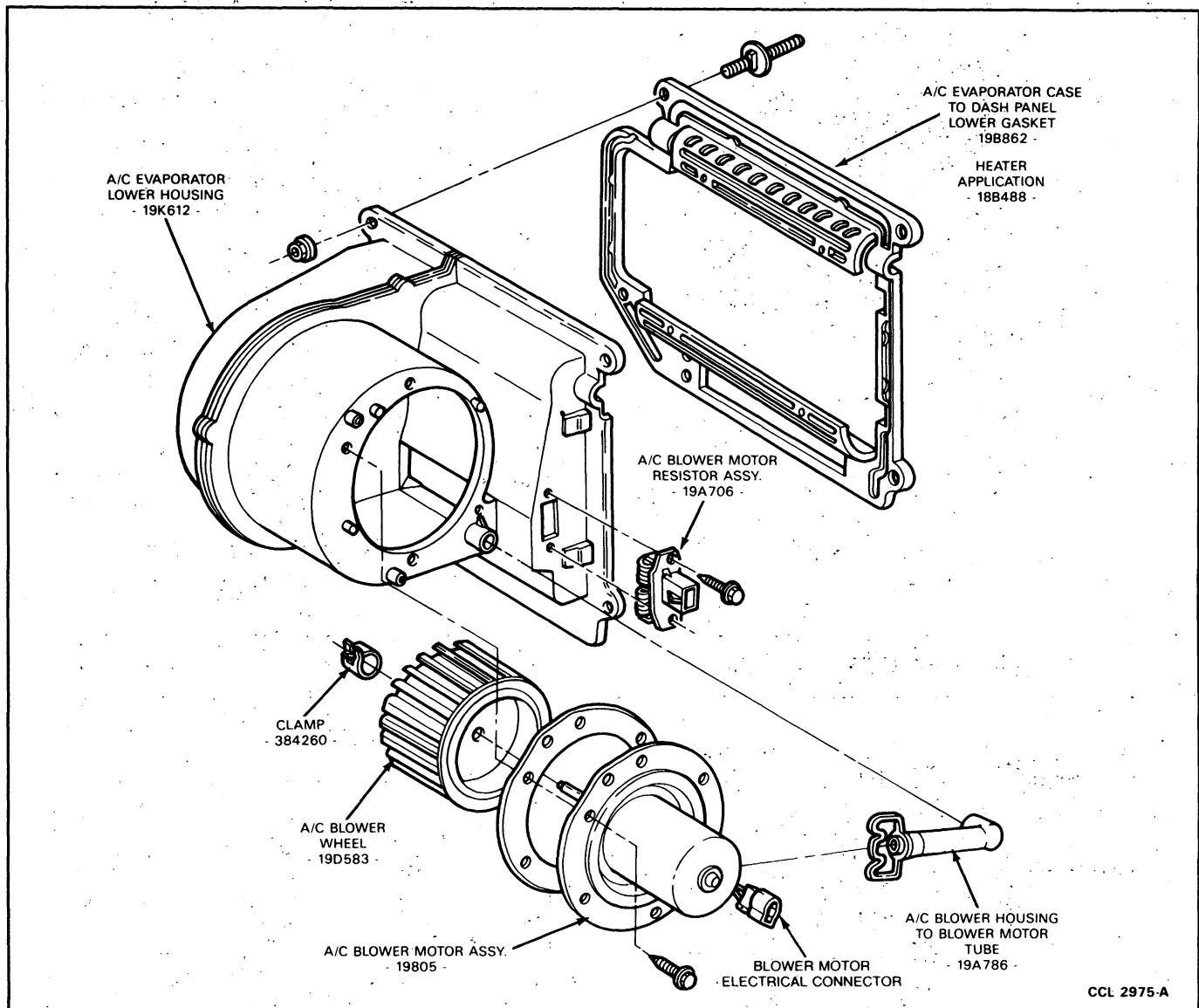


FIG. 27 Blower Motor and Wheel Assembly

orifice O-rings during removal of the fixed orifice tube from evaporator core tube.

4. Engage Fixed Orifice Tube Installer T83L-19990-A (Motorcraft YT-1008) or equivalent with the two tangs on the fixed orifice tube (Fig. 31).

**CAUTION: Do not twist or rotate the fixed tube in the evaporator core tube as it may break off the evaporator core tube.**

5. Hold the T-handle of Broken Orifice Tube Extractor T83L-19990-B or Motorcraft YT-1009 equivalent to keep it from turning and run the nut on tool down against evaporator core tube until the orifice is pulled from tube.
6. If the fixed orifice tube breaks in the evaporator core tube, it must be removed from the tube with Broken Orifice Tube Extractor T83L-19990-B or Motorcraft YT-1009.
7. To remove a broken orifice tube, insert screw end of extractor, T83L-19990-B or Tool YT-1009, into evaporator core tube and thread screw end of tool into brass tube in center of fixed orifice tube. Then, pull fixed orifice tube from evaporator core tube.

8. If only the brass center tube is removed during Step 7, insert the screw end of T83L-19990-B Tool YT-1009 into evaporator core tube and screw end of tool into fixed orifice tube body. Then, pull fixed orifice tube body from the evaporator core tube.

#### Installation

1. Lubricate O-rings on fixed orifice tube body liberally with clean refrigerant oil.
2. Place fixed orifice tube in Fixed Orifice Tube Remover/Replacer T83L-19990-A or equivalent, and insert fixed orifice tube into evaporator core tube until orifice is seated at the stop (Fig. 31).
3. Remove tool from fixed orifice tube.
4. After checking liquid line for a missing or damaged spring lock coupling garter spring and replacing or repairing, as necessary, install two new specified O-rings lubricated with clean refrigerant oil into spring lock coupling male fitting. Insert male fitting into inlet tube until spring lock is fully engaged.
5. Leak test, evacuate and charge system. **Observe all safety precautions.**

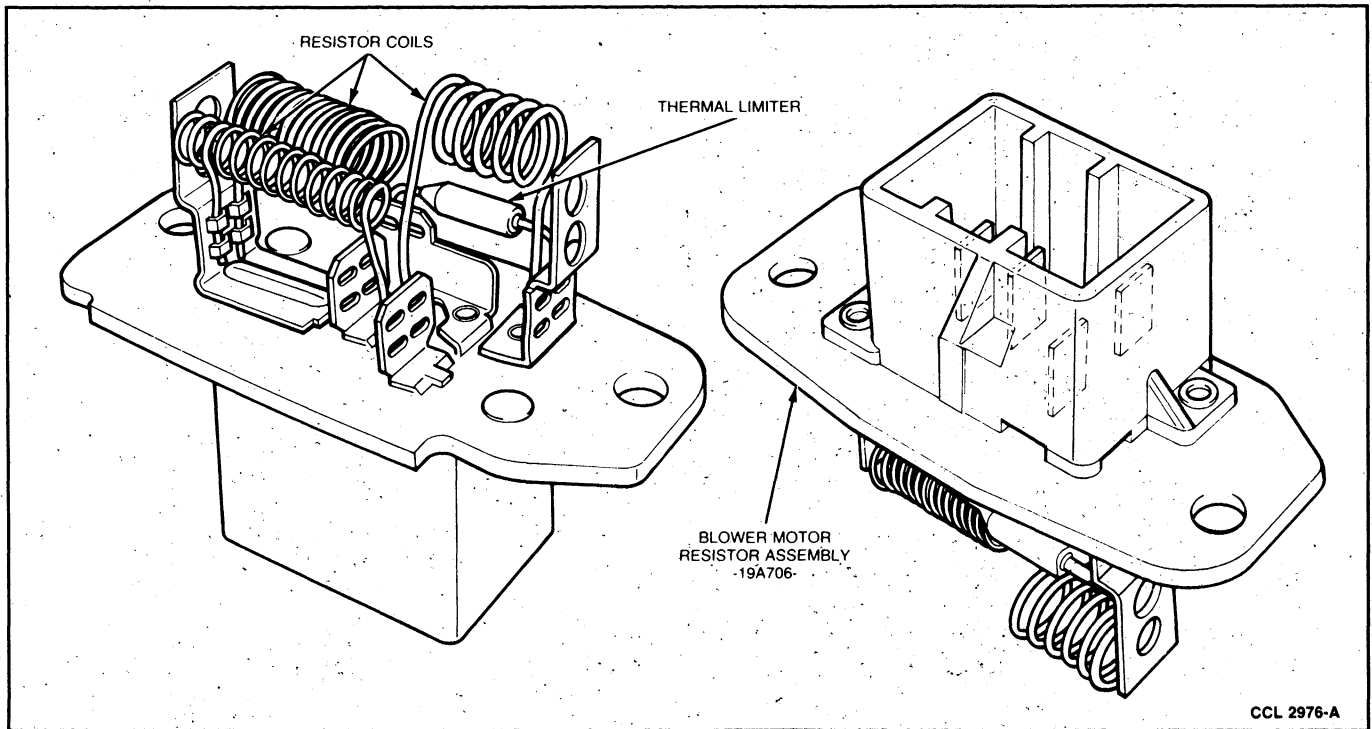


FIG. 28 Blower Motor Resistor Assembly

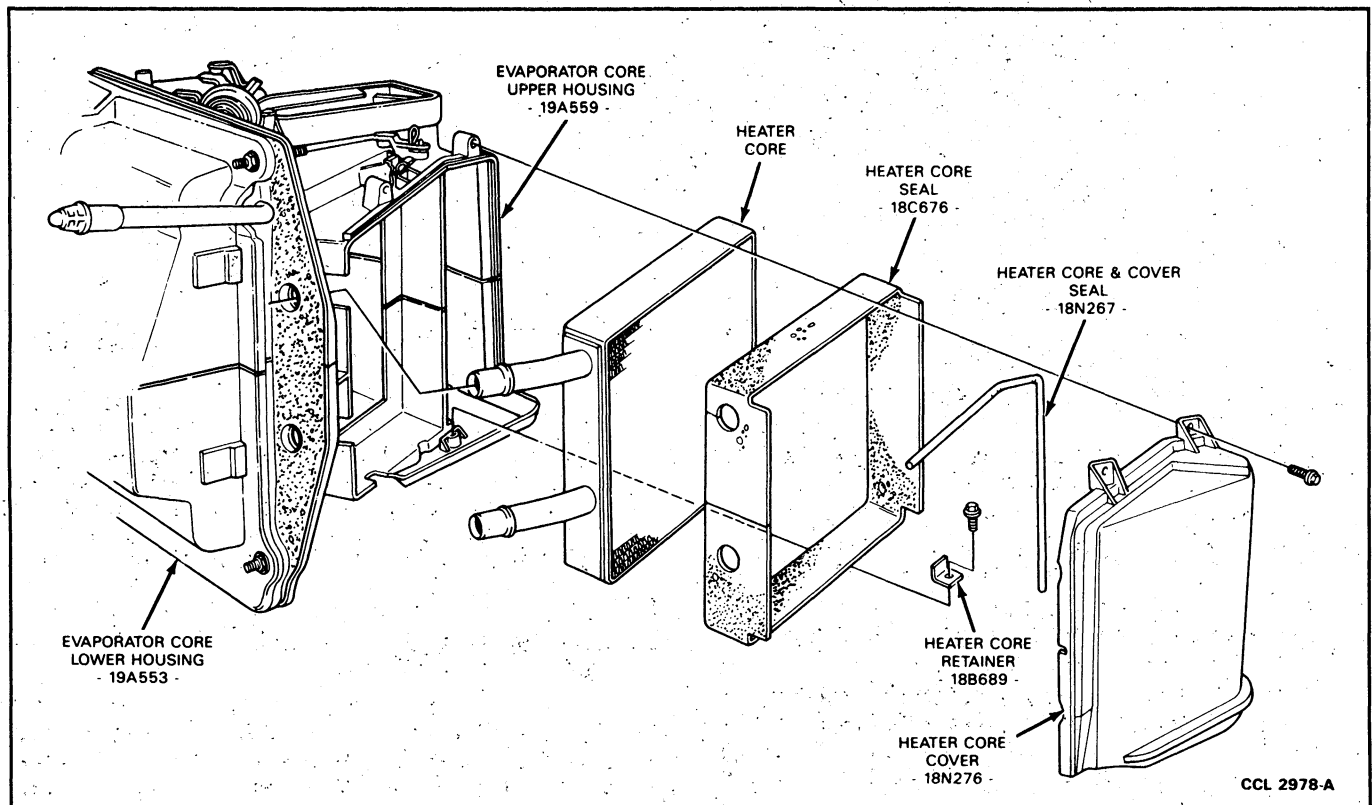


FIG. 29 Heater Core and Seal Removal



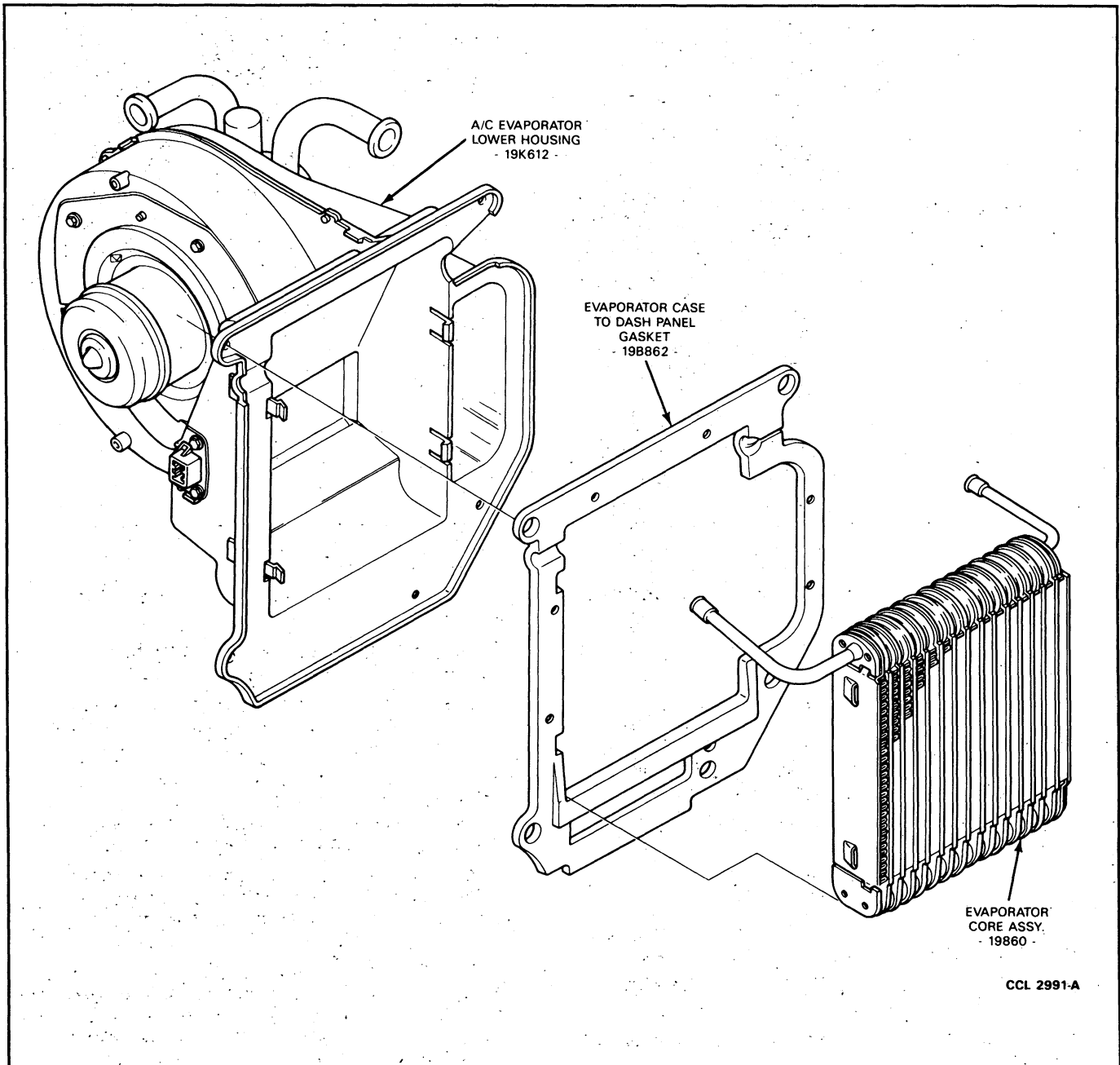


FIG. 30 Suction Accumulator/Drier

6. Check system for proper operation.

#### Condenser Assembly

**CAUTION:** Replacement of a refrigerant line or a major component such as a condenser requires replacement of the suction accumulator/drier.

The condenser assembly is mounted forward of the radiator on the radiator support (Fig. 32).

#### Removal

1. Discharge refrigerant from system following recommended procedures. Observe all safety precautions.
2. Disconnect compressor discharge line and liquid line from condenser using the spring-lock coupling tool. Refer to Fig. 11. Cap refrigerant lines to prevent entry of excessive moisture and dirt.
3. Remove two screws retaining hood latch to radiator support and position hood latch out of way.
4. Remove nine screws retaining top edge of radiator grille to radiator support.
5. Remove one screw retaining center area of grille to grille center support.
6. Remove one screw retaining grille center support to radiator support.
7. Working under vehicle, reposition splash shield and remove two condenser lower retaining nuts (Fig. 32).
8. Remove two bolts retaining the top of condenser to radiator upper support (Fig. 32).

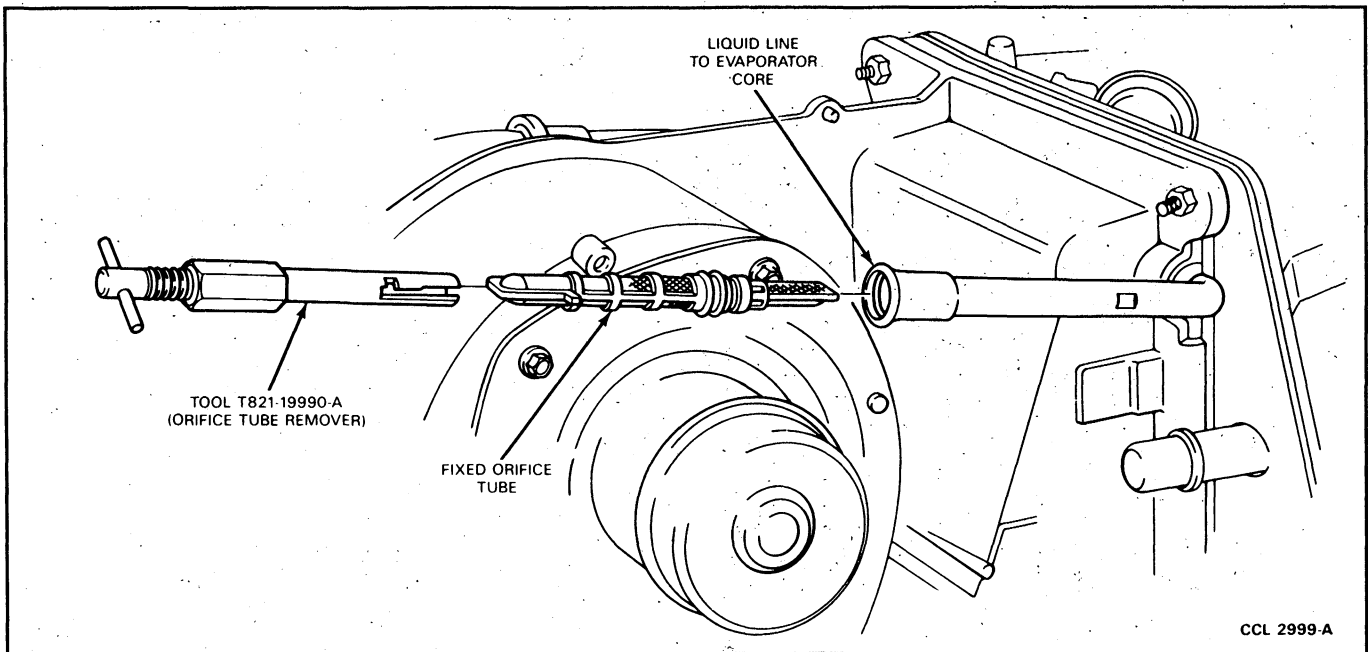


FIG. 31 Fixed Orifice Tube Removal

9. Remove four bolts retaining each end of radiator upper support to radiator side supports.
10. Carefully pull top edge of grille forward and remove radiator upper support.
11. Lift condenser from vehicle.

#### Installation

1. If the condenser is to be replaced, add one fluid ounce of clean refrigerant oil to the condenser.
2. Position condenser to vehicle and install two condenser lower retaining nuts.
3. Position radiator upper support to vehicle using care not to damage radiator grille.
4. Install four bolts retaining each end of radiator upper supports to side supports.
5. Install two bolts retaining top end of condenser to radiator upper support.
6. Install one screw retaining grille center support to radiator support.
7. Install nine screws retaining top edge of grille.
8. Install one screw retaining center area of grille to grille center support.
9. Connect compressor discharge line and liquid line to condenser. Use new O-rings lubricated with clean refrigerant oil.  
NOTE: Service parts are available for O-rings and garter springs.
10. Install hood latch and adjust latch.
11. Leak test, evacuate and charge system. **Observe all safety precautions.**
12. Check system for proper operation.

#### Suction Accumulator/Drier

Refer to Figure 33.

Replace the accumulator/drier when:

- The accumulator/drier is restricted, plugged or perforated.
- The system has been left open for more than 24 hours (system completely discharged).
- There is evidence of moisture in the system (i.e. internal corrosion of metal lines or the refrigerant oil is thick and dark).
- A component such as a condenser, evaporator refrigerant line, or a seized compressor is replaced. Flush system and replace orifice tube when replacing a seized or damaged compressor.
- There is more than five ounces of compressor oil in it, indicating that the bleed hole is clogged. (Be sure to make this check if the compressor is replaced for lack of performance or seizure).

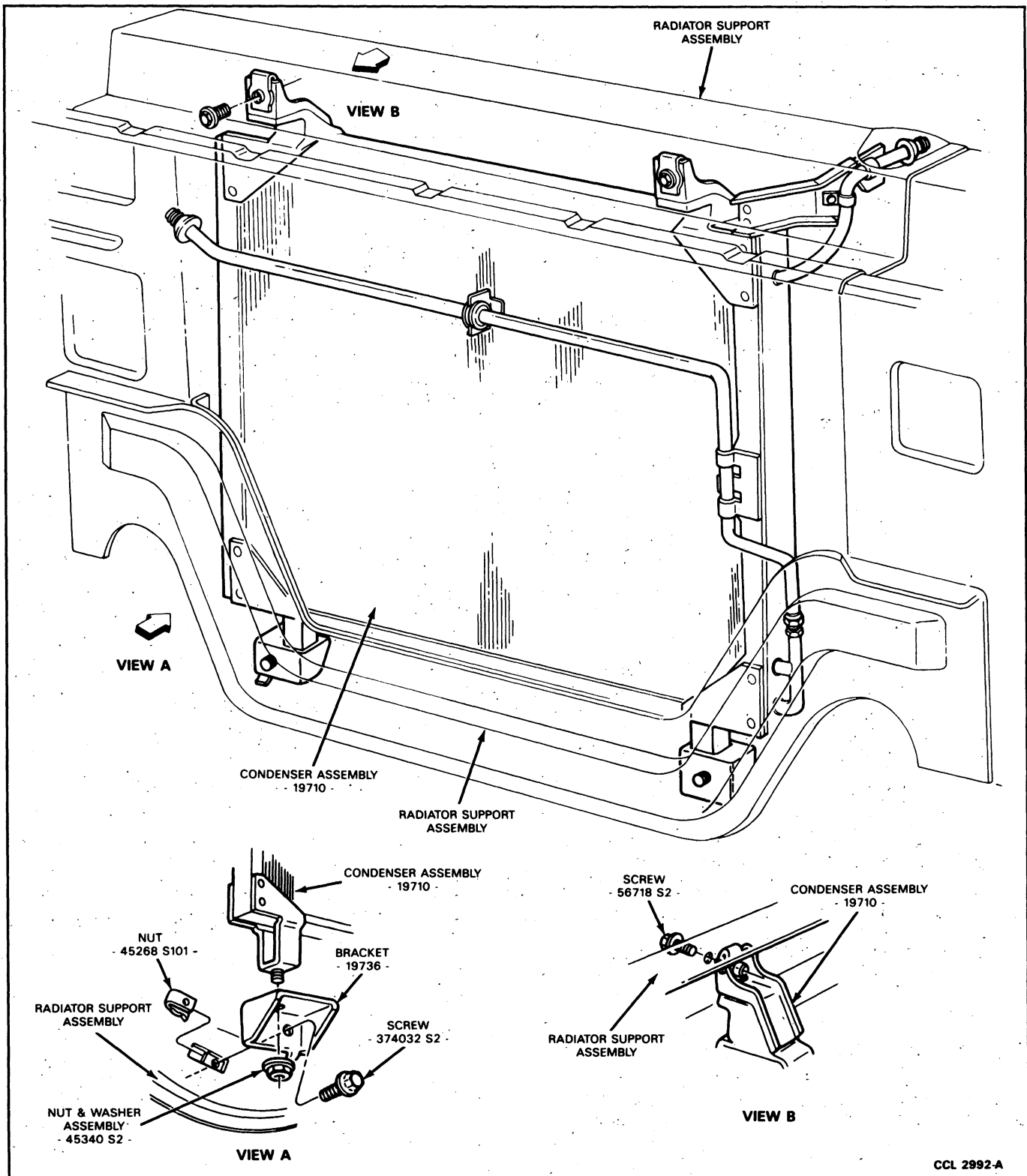
**CAUTION: The suction accumulator/drier must be replaced whenever a condenser, evaporator core, refrigerant line, seized compressor or damage to some other major component requires opening of the refrigerant circuit in order to service the difficulty.**

#### Do not replace the accumulator/drier every time:

- There is a loss of refrigerant charge.
- A component (except as described above) is changed.
- A dent is found in the outer shell of the accumulator/drier.

#### Removal

1. Discharge refrigerant from A/C system. **Observe all safety precautions.**
2. Disconnect electrical connector from pressure switch.
3. Remove pressure switch by unscrewing it from suction accumulator.
4. Disconnect suction line from suction accumulator/drier using Spring Lock Coupling Tool (Fig. 11).

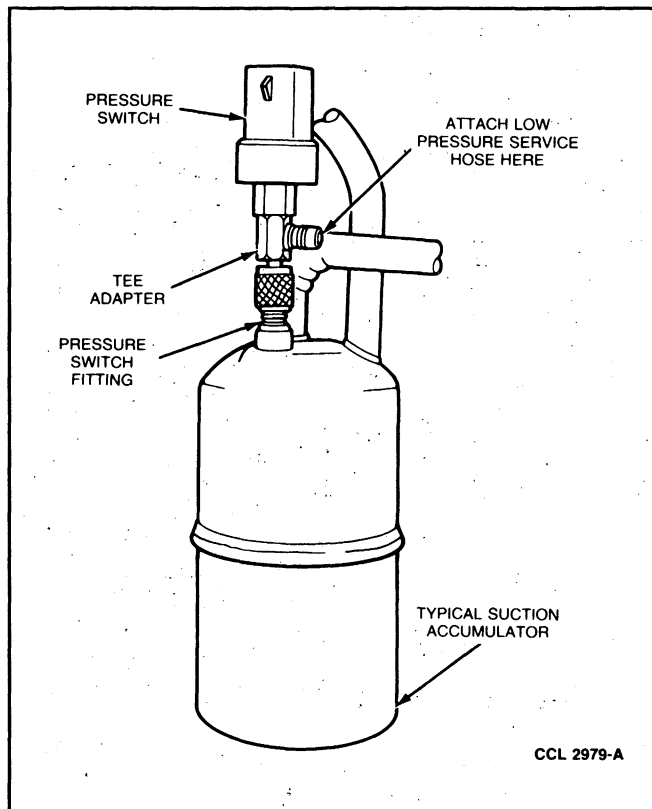


**FIG. 32 Condenser Assembly Installation**

5. Remove two mounting screws retaining bracket for the accumulator/drier. Using the Spring Lock Coupling Tool (Fig. 11), disconnect accumulator/drier from evaporator outlet tube and remove accumulator/drier. Cap all open refrigerant connections to prevent entry of dirt and moisture.

#### Installation

1. After checking male fitting on accumulator/drier for a missing or damaged spring lock coupling garter spring and replacing, ore repairing as necessary, install two new specified O-rings lubricated with clean refrigerant oil into the spring lock coupling male fitting. Insert male fitting into evaporator



**FIG. 33 Suction Accumulator/Drier**

outlet tube until spring lock is fully engaged (Fig. 11).

2. Install two mounting screws on the bracket for the accumulator/drier. Tighten screws to 1.7 N·m (15 in-lb) minimum.
3. After checking suction line for missing or damaged spring lock coupling garter spring and replacing as necessary, install two new specified O-rings lubricated with clean refrigerant oil into spring lock coupling male fitting. Insert male fitting into accumulator/drier until spring lock is fully engaged.
4. Use a new O-ring lubricated with clean refrigerant oil on pressure switch nipple of suction accumulator/drier. Install pressure switch and tighten to 7-13 N·m (5-10 ft-lb) if switch has metal base, and hand-tight only if switch has plastic base.

### Compressor Assembly

**CAUTION: Replacement of a refrigerant line or a major component, such as a compressor requires replacement of the suction accumulator/drier.**

#### 4.9L (300 CID) Engines

##### Removal

1. Discharge refrigerant from system following recommended service procedures and safety precautions in Section 36-30, Air Conditioning General Service.
2. Disconnect wire connector from clutch field coil connector.
3. Remove retaining bolts from compressor manifolds and remove refrigerant lines. Plug refrigerant lines

and compressor ports to prevent entrance of dirt and moisture.

4. Remove hex-head screw retaining compressor adjusting arm to mounting bracket (Fig. 34).
5. Remove four screws retaining front and rear braces to mounting bracket support. Remove compressor with front and rear braces attached.
6. Remove front and rear braces from compressor (two screws each).

##### Installation

1. If a new service replacement compressor is being installed, remove shipping plates and pour 120ml (four fluid ounces) of refrigerant oil into the compressor through compressor ports.
  2. Transfer clutch components to new compressor. Refer to Section 36-37 FX-15 Compressor and Clutch. Be sure to follow recommended procedures using tools specified.
  3. Install front and rear braces on compressor. Tighten retaining screws to specification. Refer to Figure 34.
  4. Position compressor braces on mounting bracket support and install four retaining screws.
  5. Install but do not tighten, hex-head screw attaching compressor adjusting arm to mounting bracket.
  6. Install drive belt and adjust to specification as described in Section 27-06, Accessory Drive Belt.
  7. Tighten four compressor screws and braces to mounting bracket support retaining screws and hex-head screw to specification.
  8. Position compressor manifolds over compressor ports and start attaching bolts. Tighten bolts to 17-23 N·m (13-17 ft-lb).
- CAUTION: Be sure bolts are not cross-threaded before tightening. Do not over-tighten bolts or the aluminum threads may become stripped.**
- Use new O-rings lubricated with clean refrigerant oil.
9. Connect clutch wires to clutch field coil.
  10. Leak test, evacuate and charge system, then check for proper operation.

### V-8 Gasoline Engines

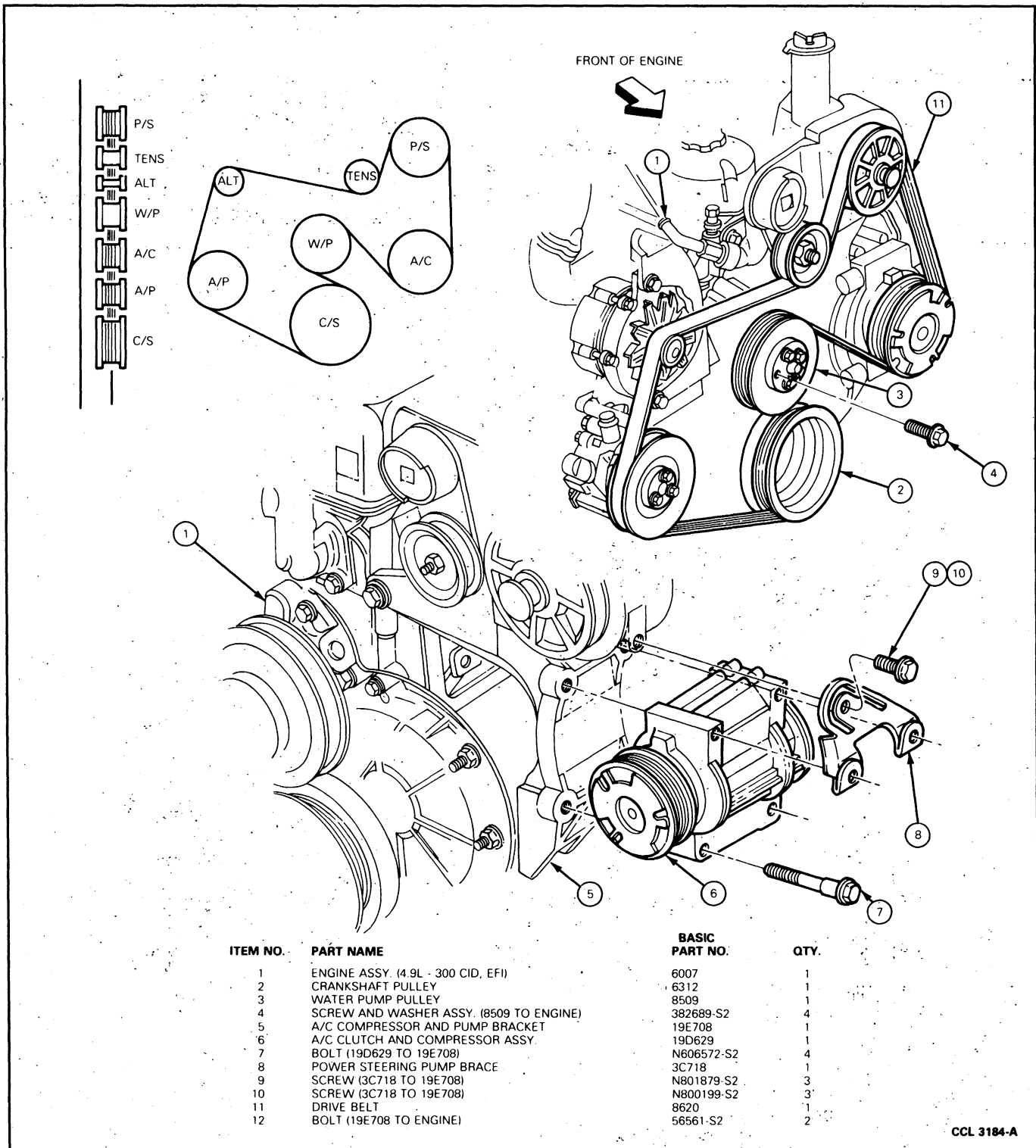
Refer to Figures 35 and 36.

##### Removal

1. Discharge refrigerant from system following recommended service procedures and safety precautions in Section 36-30, Air Conditioning General Service.
2. Disconnect wire connector from clutch field coil connector.
3. Remove retaining bolts from compressor manifolds and remove refrigerant lines. Plug refrigerant lines and compressor ports to prevent entrance of dirt and moisture.
4. Remove bolts retaining compressor to brackets and remove compressor.

##### Installation

1. If a new service replacement compressor is being installed, remove shipping plugs and pour 120ml



**FIG. 34 FX-15 Compressor Installation—4.9L, 6-Cylinder Engine**

- (four fluid ounces) of refrigerant oil into compressor.
- Transfer clutch components to new compressor. Refer to Section 36-37, FX-15 Compressor and Clutch.
  - Position compressor on its mounting brackets and install five retaining bolts. Tighten to specifications. Refer to Figures 35 and 36.
  - Install drive belt and adjust as described in Section 27-06, Accessory Drive Belt Service.
  - Position compressor manifolds over compressor ports and start the retaining bolts. Tighten bolts to 17-23 N·m (13-17 ft-lb).
- CAUTION: Be sure bolts are not cross-threaded before tightening. Do not over tighten bolts or the aluminum threads may become stripped.**

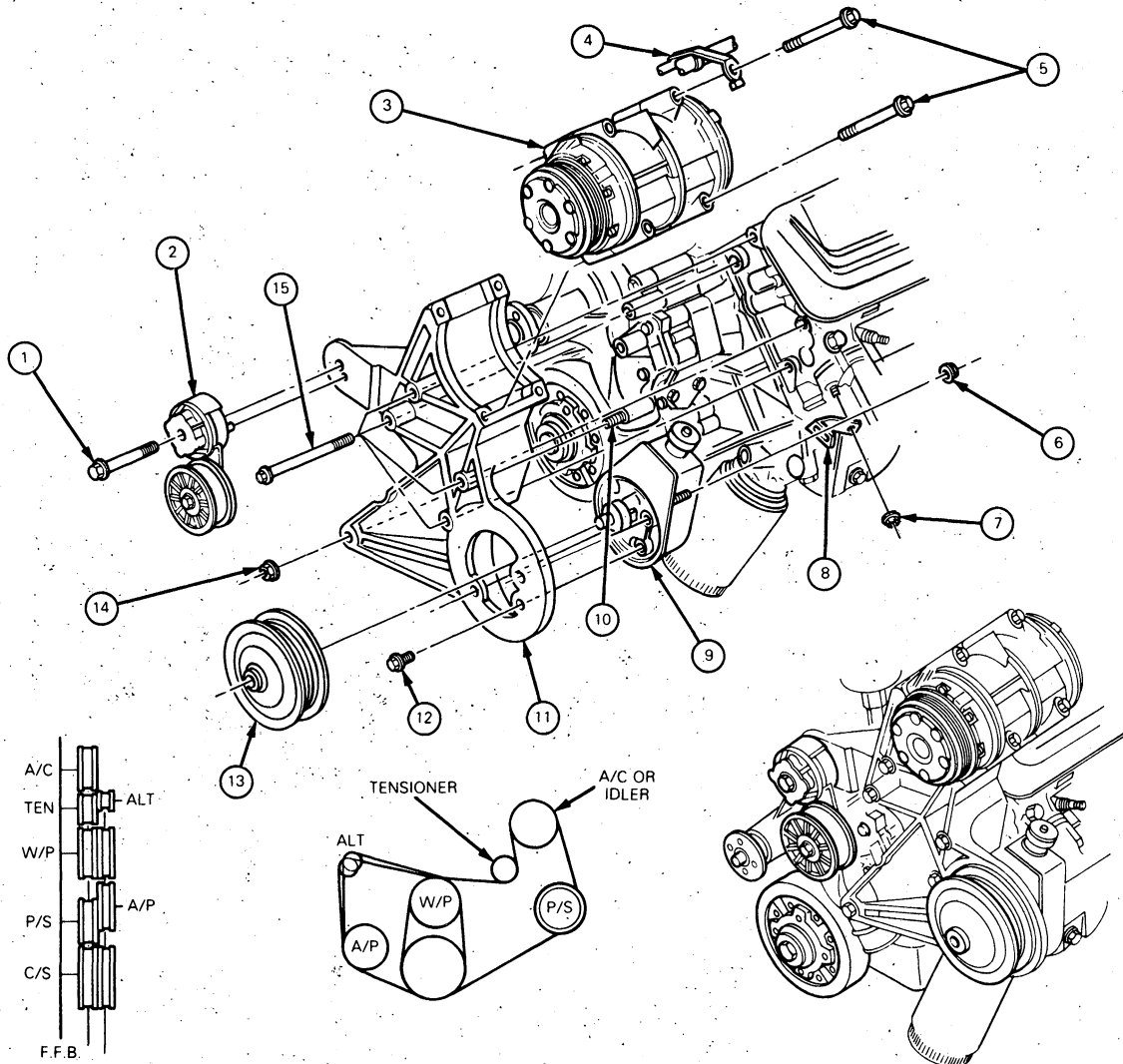
Use new O-rings lubricated with clean refrigerant oil.

6. Connect clutch field coil connector.
7. Leak test, evacuate and charge system as described in Section 36-30, Air Conditioning General Service.
8. Check compressor for proper operation.

### 7.3L Diesel Engine (6E171 Compressor)

#### Removal

1. Discharge refrigerant from system following recommended service procedures and safety precautions in Section 36-30, Air Conditioning General Service.
2. Disconnect connector from clutch field coil.
3. Remove retaining bolts from compressor manifolds and remove refrigerant lines. Plug refrigerant lines



ITEM NO.	PART NAME	BASIC PART NO.	QTY.
1	BOLT (6B209 TO 19E708)	56192-S2	1
2	BELT TENSIONER ASSY.	6B209	1
3	CLUTCH & COMPRESSOR ASSY.	19D629	1
4	A/C BRACKET	19B890	1
5	BOLT (19D629 TO 19E708)	N606572-S2	4
6	NUT (3C718 TO 3A674)	N801206-S2	1
7	NUT (3C718 & 6750 TO 6007)	REF.	REF.
8	P/S PUMP BRACE	3C718	1
9	P/S PUMP	3A674	1
10	A/C COMPRESSOR & P/S PUMP BRACKET MOUNTING STUD	PIA ENGINE	1
11	A/C COMPRESSOR & P/S PUMP BRACKET	19E708	1
12	SCREW (3A674 TO 19E708)	N800199-58M	3
13	P/S PULLEY ASSY.	3D673	1
14	NUT (19E708 TO 6007)	382802-S2	1
15	BOLT (19E708 TO 6007)	56776-S2	4
	BOLT (19E708 TO 6007)	56576-S2	4

CCL 3183-A

FIG. 35 FX-15 Compressor Installation—7.5L Engine

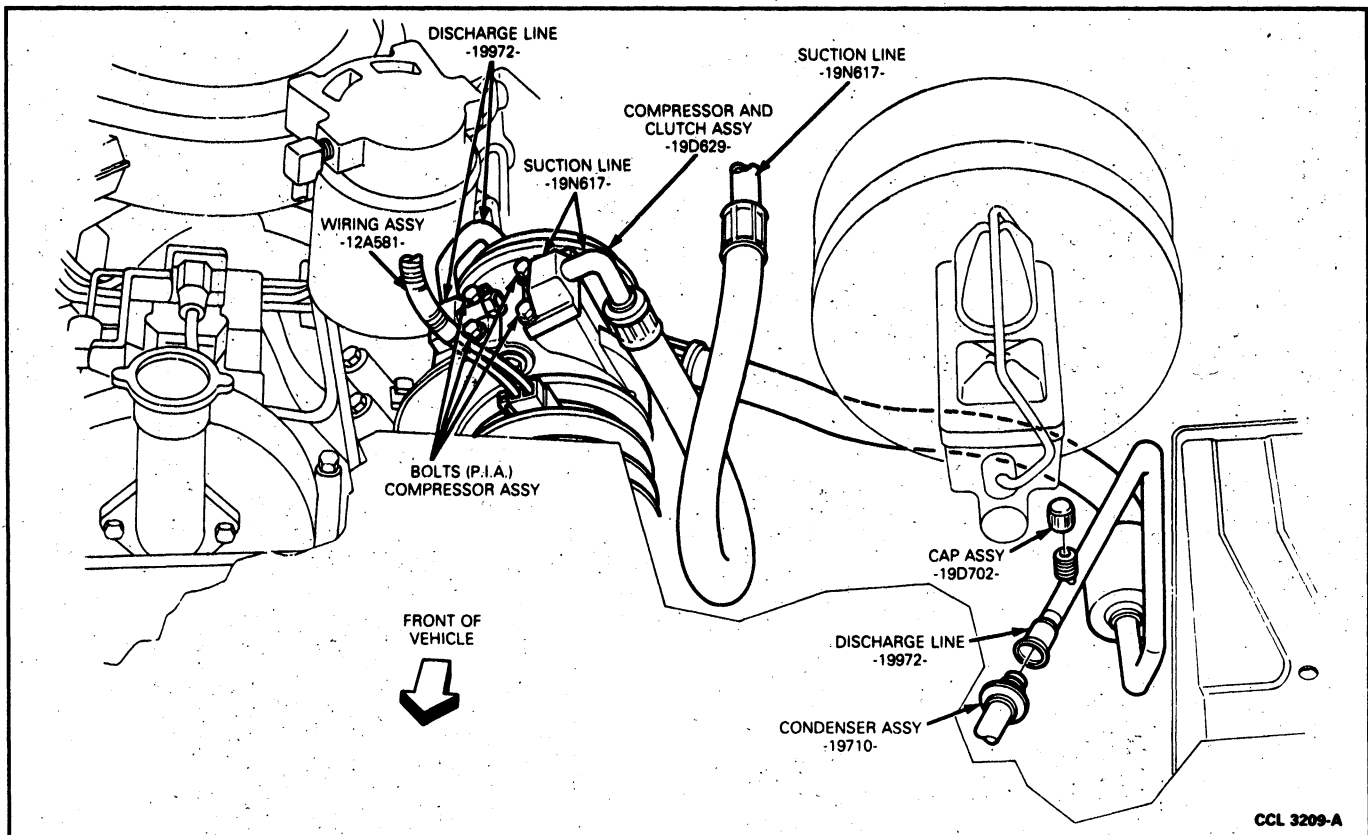


FIG. 36 FX-15 Compressor Installation—5.0L and 5.8L Engines

and compressor ports to prevent entrance of dirt and moisture. Refer to Fig. 37.

4. Loosen pivot bolt and adjusting bolts.
5. Remove drive belt from compressor pulley and position out of the way.
6. Remove five bolts retaining compressor to brackets and remove compressor from vehicle.

#### Installation

1. If a new service replacement compressor is being installed, remove shipping plates and pour 120ml (four fluid ounces) of refrigerant oil from compressor through compressor ports.
2. Transfer clutch components to new compressor. Refer to Section 36-37, FX-15 Compressor and Clutch.
3. Position compressor to mounting brackets.
4. Install retaining bolts.
5. Position compressor manifolds over compressor ports and start retaining bolts. Tighten bolts to 17-23 N·m (13-17 ft-lb).

**CAUTION:** Be sure the bolts are not cross-threaded before tightening. Do not over tighten the bolts or the aluminum threads may become stripped.

6. Connect clutch coil electrical connector.
7. Install drive belt on compressor drive pulley and adjust belt tension to specification. Refer to Section 27-06, Accessory Drive Belt Service.
8. Leak test, evacuate and charge system. Refer to Section 36-30, Air Conditioning General Service.
9. Check compressor for proper operation.
10. Remove fender cover and close hood.

#### Compressor Clutch and Field Coil

Refer to Section 36-36 and 36-34 for information on the FX-15 and 6E171 compressor and clutch assembly.

#### Heater Hose and A/C Line Routing

Figures 38 through 42 illustrate heater hose and A/C line routing for the 4.9L (300 CID), 5.0L (302 CID), 5.8L (351 CID), 7.5L (460 CID) gasoline engines and 7.3L (447 CID) diesel engine.

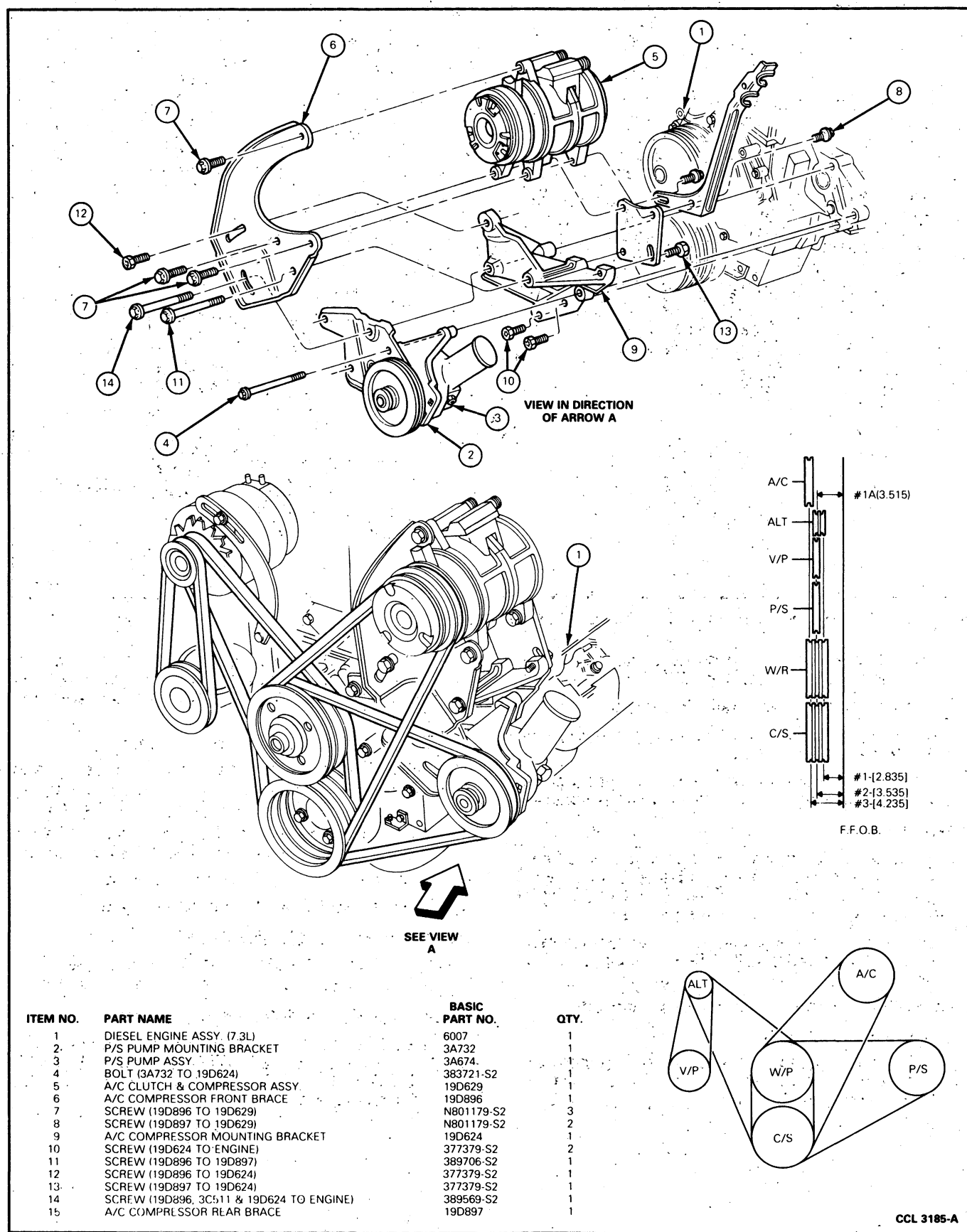


FIG. 37 6E171 Compressor Installation—7.3L Diesel Engine



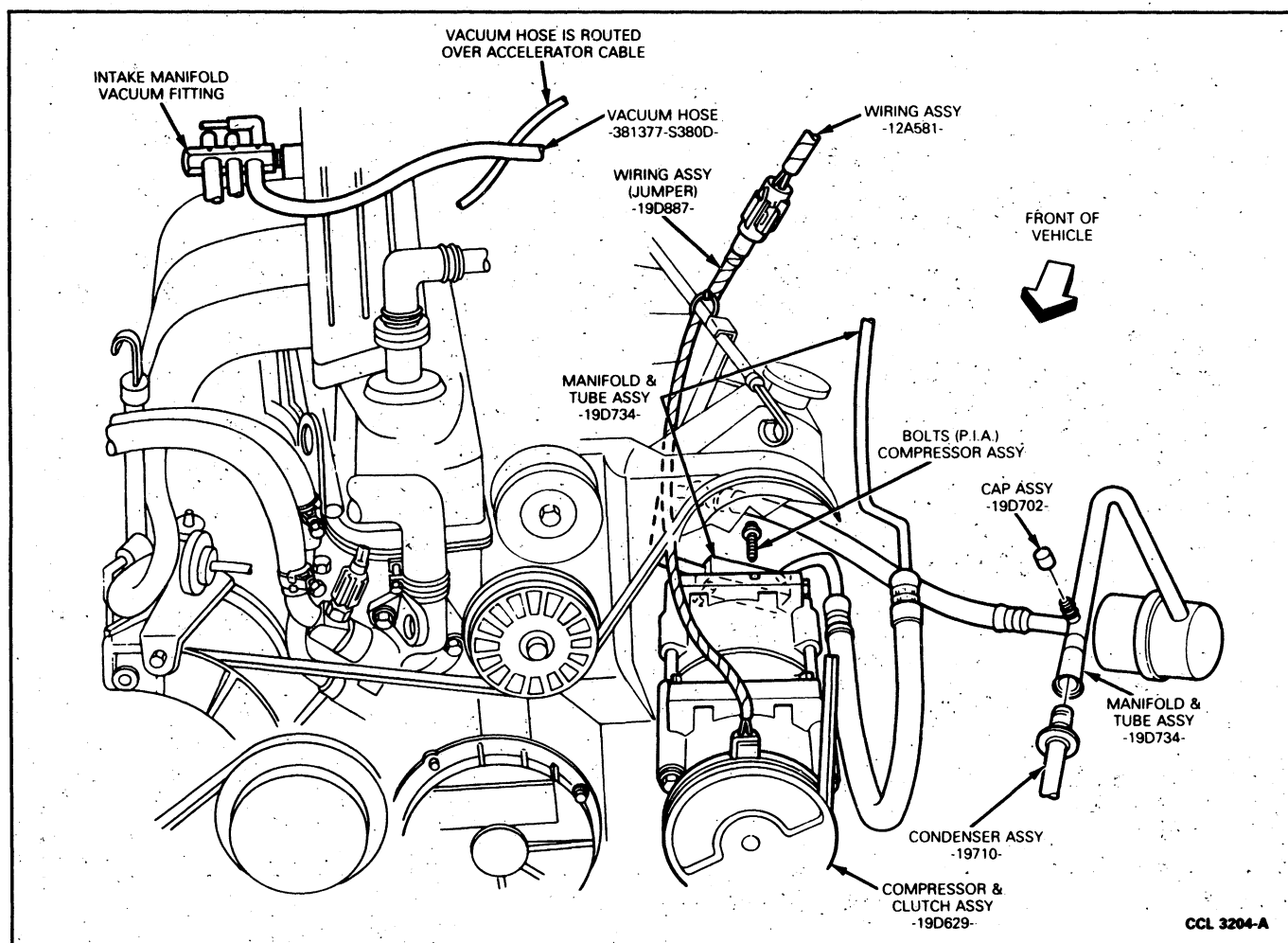


FIG. 38 Heater Hose and A/C Line Routing—4.9L Engine

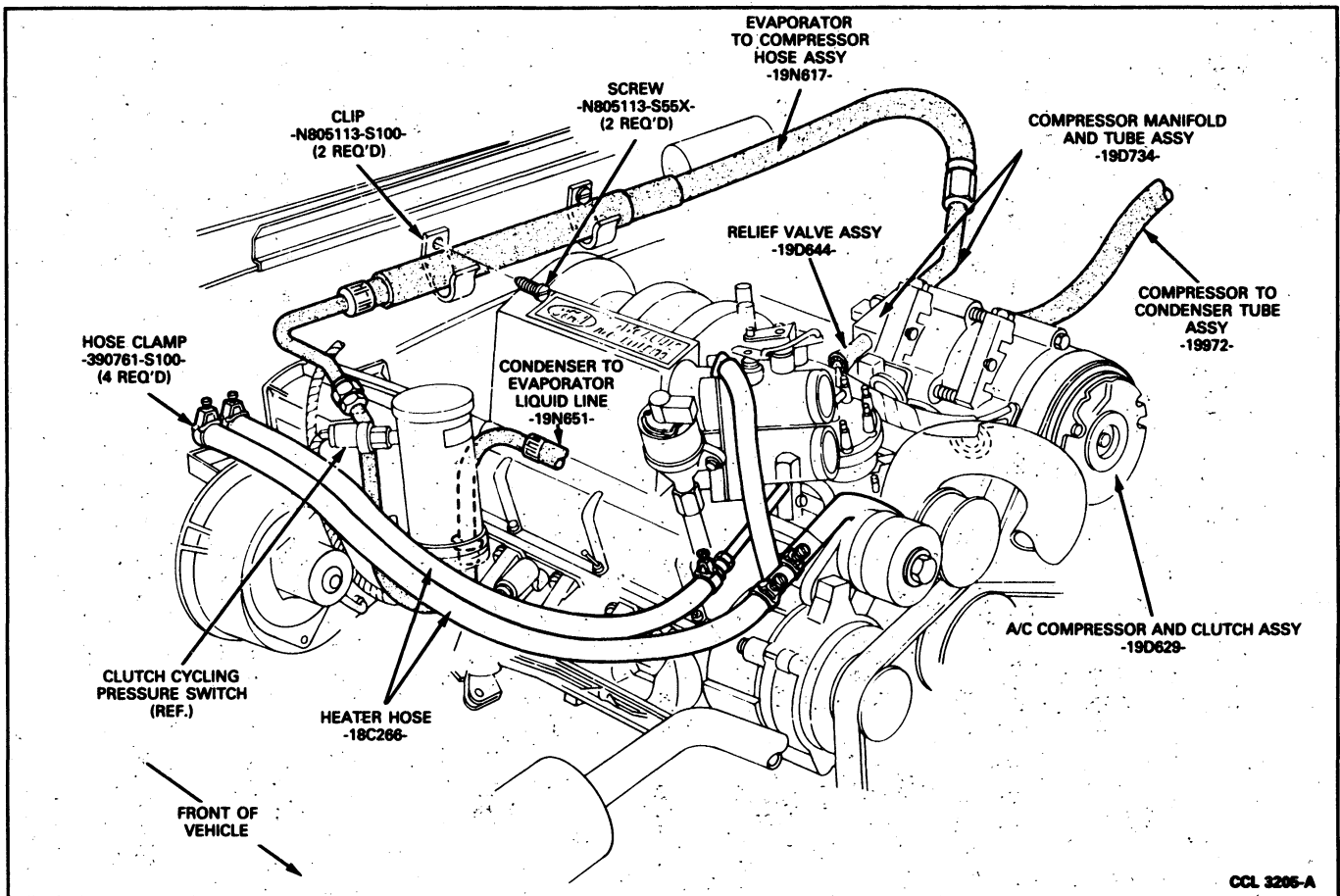


FIG. 39 Heater Hose and A/C Line Routing—5.0L Engine

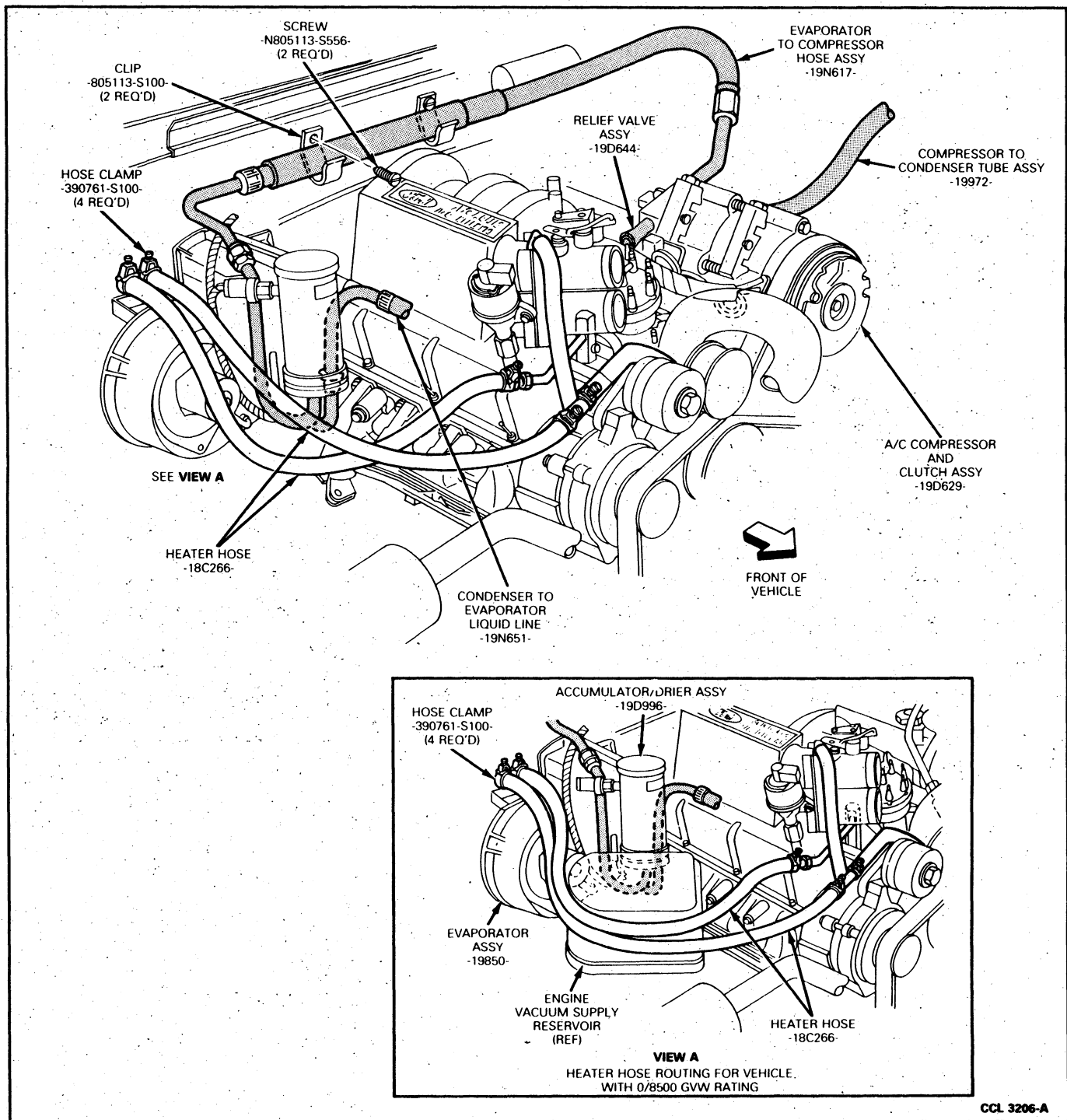


FIG. 40 Heater Hose and A/C Line Routing—5.8L Engine

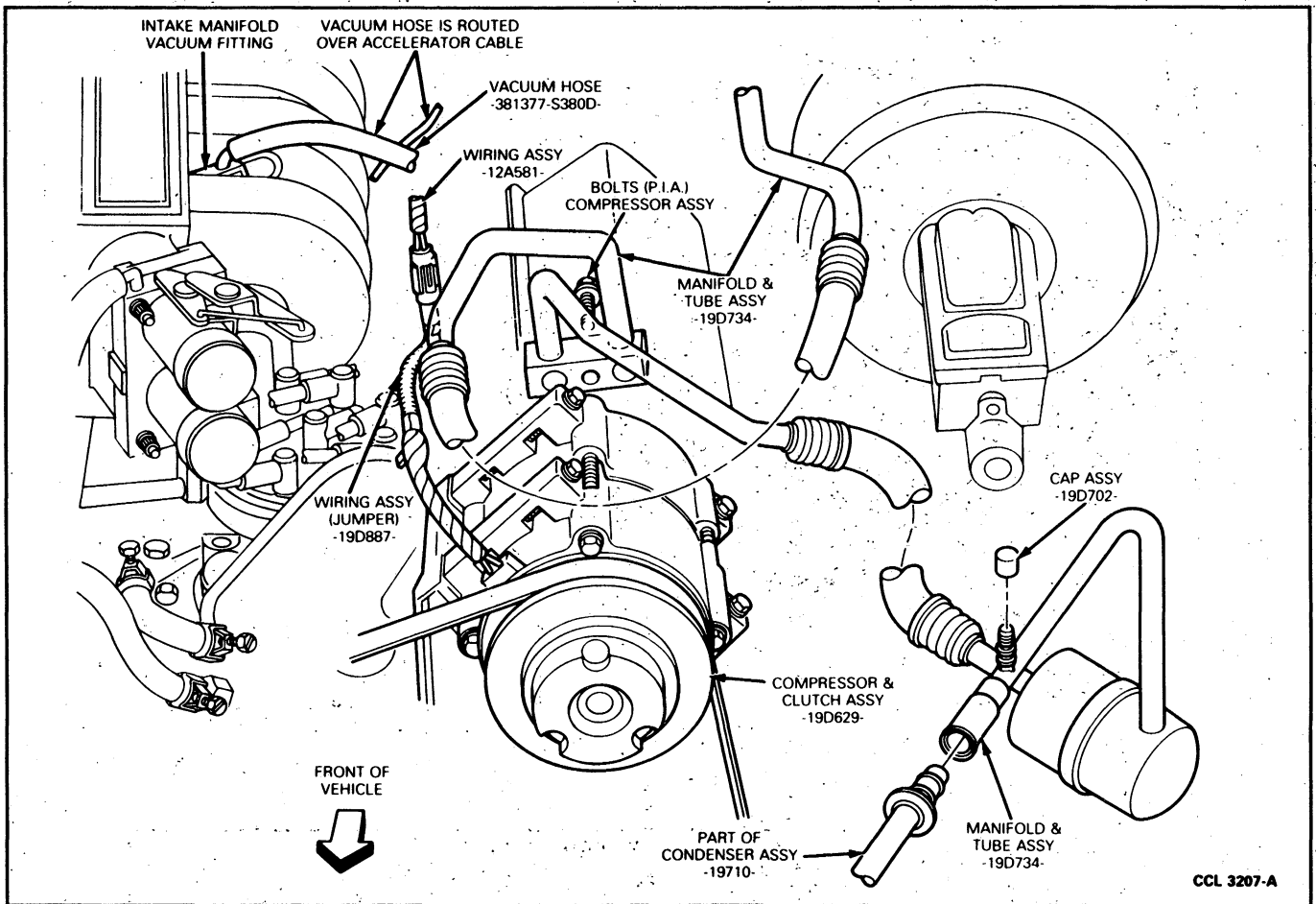


FIG. 41 Heater Hose and A/C Line Routing—7.5L Engine

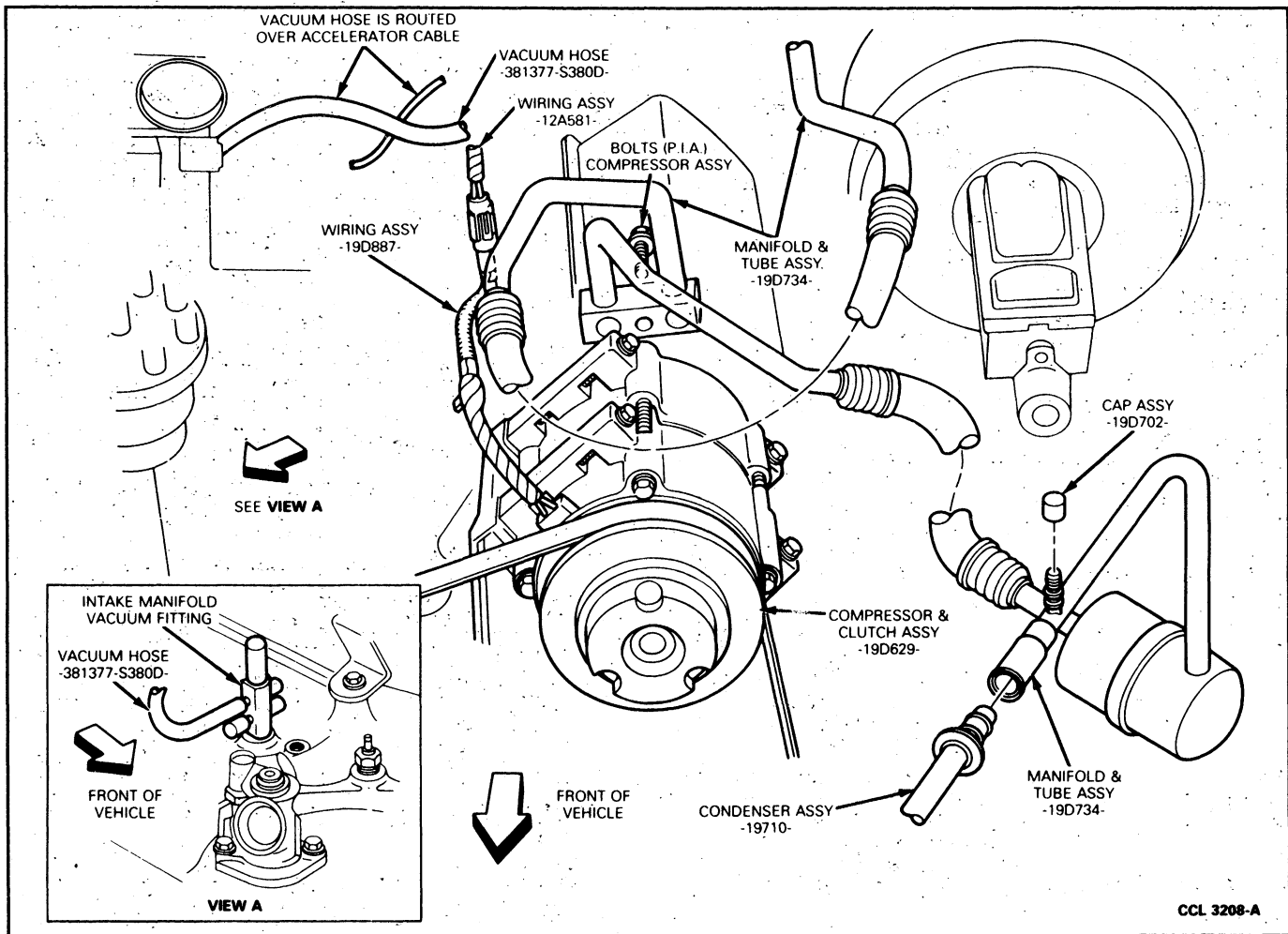


FIG. 42 Heater Hose and A/C Line Routing—7.3L Diesel Engine

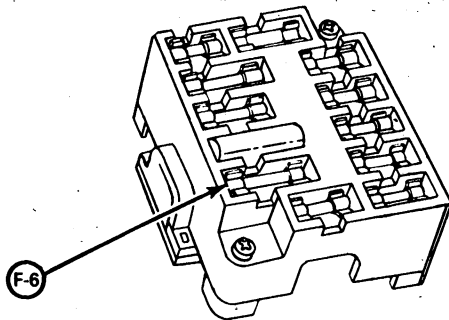
## SPECIFICATIONS

## ELECTRICAL

Protective Device	35 Amp. Fuse (F-6) in Fuse Panel Thermal Limiter in Blower Resistor Circuit (Integral with Resistor)		
Blower Motor	Blower Speed	Amps	Volts
Current Draw	Low	6.0	5
(Amps and Voltage)	Med. Low	8.0	7
	Med. High	15.0	10
	High	25.0	12.8
Magnetic Clutch			
Current Draw — Approximately 3.75 Amps @	12.8 Volts.		
Illumination			
Control Assembly	One ICP-161 Bulb		

## REFRIGERANT

Cycling Clutch Control De-Icing Switch	Close 42°F Open 28°F
System Protection	
High Pressure Relief Valve	Opens 3103kPa (450 psi)
Capacity (Front System Only)	3-1/2 Lbs. Plus 1/4 Lb. Minus 0 56 Oz. Plus 4 Oz. Minus 0 1.588 Kg. Plus .113 Kg. Minus 0
(Front and Auxiliary System)	4-1/4 Lbs. Plus 1/4 Lb. Minus 0 68 Oz. Plus 4 Oz. Minus 0 1.928 Kg. Plus .113 Kg. Minus 0
Type	
Refrigerant 12 (R-12)	Dichlorodifluoromethane CCL <sub>2</sub> F <sub>2</sub>
ESA-M17B2A	Ford D4AZ-19B519-A Motorcraft YN1-A 14 Oz. Can YN-7 30 Lb. Container



The fuse panel is located on the dash panel in passenger compartment left of steering column.

## SPECIAL SERVICE TOOLS

Description	Number	Motorcraft
Belt Tension Gage	T63L-8620-A	YT-371
Heater Control Cable Disconnect Tool	T83P-18532-AH	—
Spring Lock Coupling Tool — 1/2 inch	T81P-19623-G2	—
5/8 inch	T83P-19623-C	—
3/8 inch	T81P-19623-G1	—
3/4 inch	T85L-19623-A	—
Service Access Adapter	D81L-19703-A	YT-354
Tee Adapter	D87P-19703-A	—
Fixed Orifice Tube Remover/ Replacer	T83L-19990-A	—
Broken Orifice Tube Remover/ Replacer	T83L-19990-B	—

## ROTUNDA EQUIPMENT

Description	Number	Motorcraft
Flame Type Leak Detector	023-00006	YT-202
Dial Thermometer	023-00007	YT-227
Small Can Adapter	023-00009	YT-229
Safety Shield Goggles	063-00003	YT-204
Electronic Leak Detector	055-00015	YT-288
Manifold Gauge Set	063-00010	YT-201
Vacuum Tester	021-00014	—

## TORQUE LIMITS

Description	Torque		
	Ft-Lb	In-Lb	N-m
Suction Hose to Evaporator Core	30-35		41-47
Liquid Line to Expansion Valve	10-15		14-20
Heater Hose Clamps		12-18	1.35-2.03
Condenser to Mounting Bracket	12-18		17-24
Condenser Mounting Bracket to Radiator Support	12-18		17-24
Compressor to Bracket	20-32		28-43
Compressor Bracket to Support to Engine (4.9L)	45-65		62-88
Compressor Adjusting Bracket to Support Bracket (4.9L)	30-45		41-61
Compressor Bracket to Engine (8-Cylinder)	45-65		62-88
Idle Pulley to Bracket (8-Cylinder)	30-45		41-61
Compressor Brace to Engine	30-45		41-61
Compressor Brace to Compressor	20-32		28-43
Evaporator Case to Dash Panel	30-40		3.38-4.51
Plenum to Evaporator Case	12-17		1.35-1.92
Temperature Cable			
To Bracket at Evaporator Case	17-22		1.92-2.48
To Control Assembly	10-15		1.12-1.69
Defrost Nozzle to Instrument Panel Opening		9-15	1.02-1.69
Control Assembly to Support Bracket	10-15		1.12-1.69
Control Support Bracket to Instrument Panel	17-22		1.92-2.48

CL3449-2G

# SECTION 36-70 Side-Mounted Auxiliary A/C and/or Heater Systems

SUBJECT	PAGE	SUBJECT	PAGE
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## VEHICLE APPLICATION

E-150 Through E-350.

## DESCRIPTION

An auxiliary climate control system is available as an option that can be used in combination with some of the main climate control system. The chart in Fig. 1 lists the main and auxiliary system applications.

The auxiliary system is available as a combination air conditioning and heating system if the main system has the same combination. Fig. 2 illustrates the components of a typical auxiliary air conditioning and heating system.

The interior components of the system are mounted on the LH side of the vehicle, between the side windows and floorpan and rearward of the driver's seat. All components, including the blower motor and wheel, resistor, wiring grommet and seal, A/C core and seal, heater core and seal, and expansion valve, are serviceable from the inside of the vehicle.

BODY STYLE	HEATER		A/C - HEATER	
	BASE SYS.	AUX. SYS. ①	BASE SYS.	AUX. SYS. ①
REG. CARGO VAN	X	X	X	X
SUPER CARGO VAN	X	X	X	X
REG. WINDOW VAN	X	X	X	X
SUPER WINDOW VAN	X	X	X	X
REG. CLUB WAGON	X	X	X	②
SUPER CLUB WAGON	X	X	X	②

NOTES:

① NOT AVAILABLE ON VEHICLES WITH A 124" WHEELBASE WITH P205 TIRES

② NOT AVAILABLE ON CLUB WAGONS WITH BASE TRIM

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**FIG. 1 Main and Auxiliary Climate Control System Applications**

To remove any of the components, it is necessary to remove the auxiliary A/C-heater cover assembly and the first bench seat on vehicles so equipped. To service the heater and/or air conditioner as an assembly, it is also necessary to remove the LH side window garnish moulding and loosen the forward portion of the auxiliary duct assembly. The duct assembly is attached to the side of the body with ten screws.

## Control Assembly

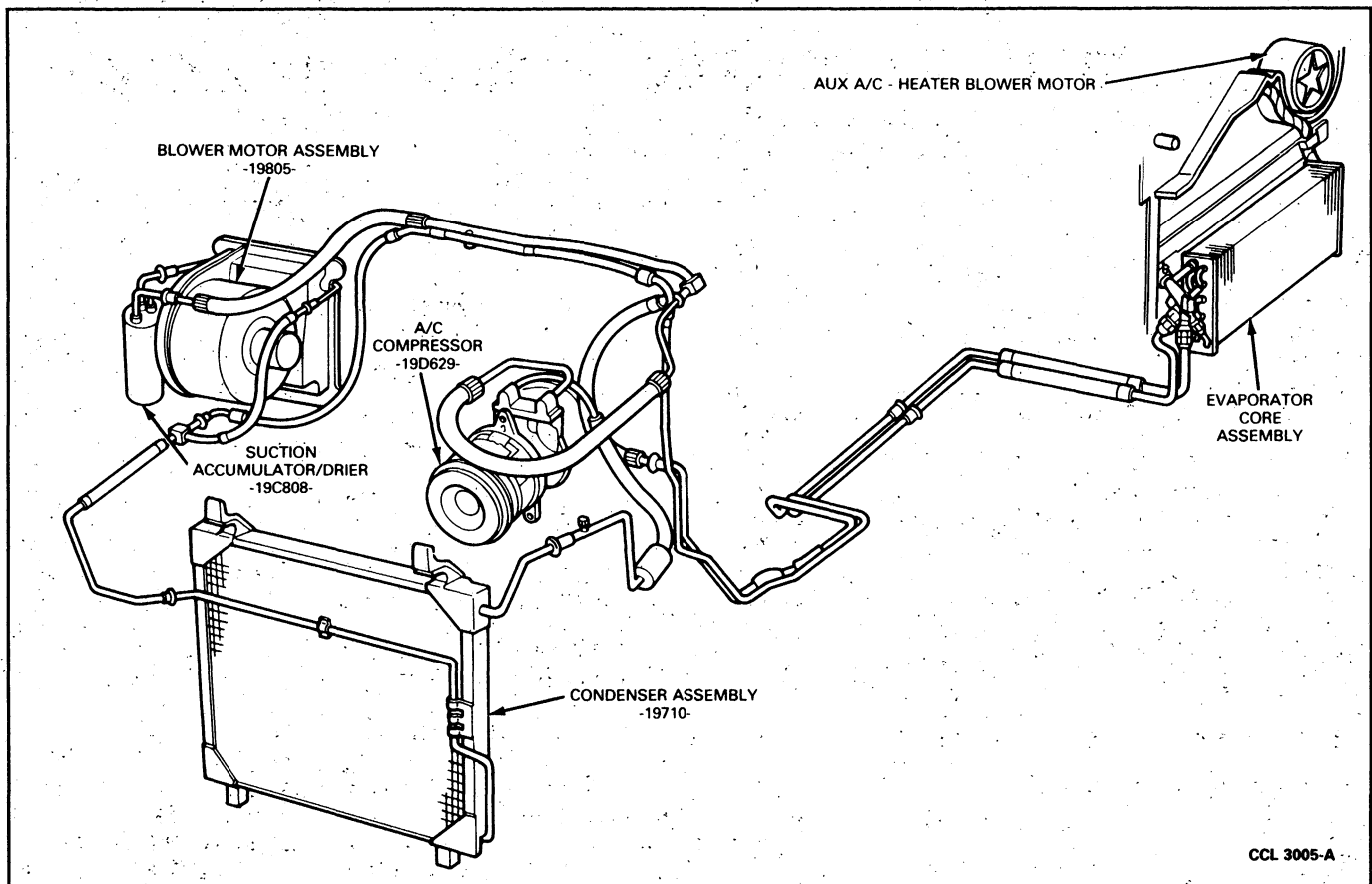
Fig. 3 illustrates the type of control assembly that would be installed when: 1) the vehicle is equipped with an A/C-heater system or 2) equipped with a heater only system. From the location of the control in the instrument panel, the driver and front seat passenger have access to the function and temperature levers in the main system, as well as to the separate switches that control blower motor speeds in the main and auxiliary units.

The auxiliary blower switch provides four operating speeds (HIGH, MEDIUM HIGH, MEDIUM LOW, and LOW) plus an OFF position. This switch is located near the right edge of the control assembly. The auxiliary blower switch will not function in any of its operating positions unless the function selector lever in the main system is in a position other than OFF.

## Function Selector Lever

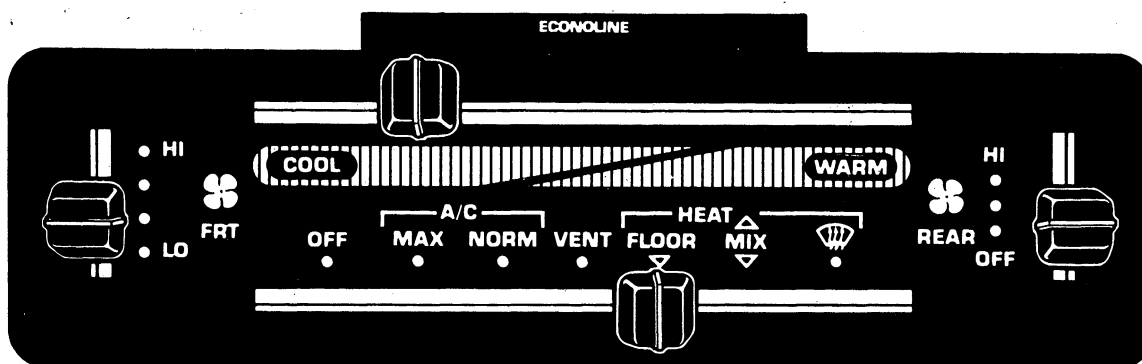
In addition to using the thumbwheel louver control in the four (of five) rearward auxiliary duct registers, the rear seat passengers can adjust airflow with a 3-position function selector lever. Refer to Fig. 4.

As shown, a door operated by the lever can be set fully forward to direct all airflow to the four rear duct registers. (The forward duct register is located ahead of the function lever. As a result, it is not affected by lever position.) With the door in the middle position, airflow is directed in approximately equal quantities to the duct register and floor outlets. With the door in the fully



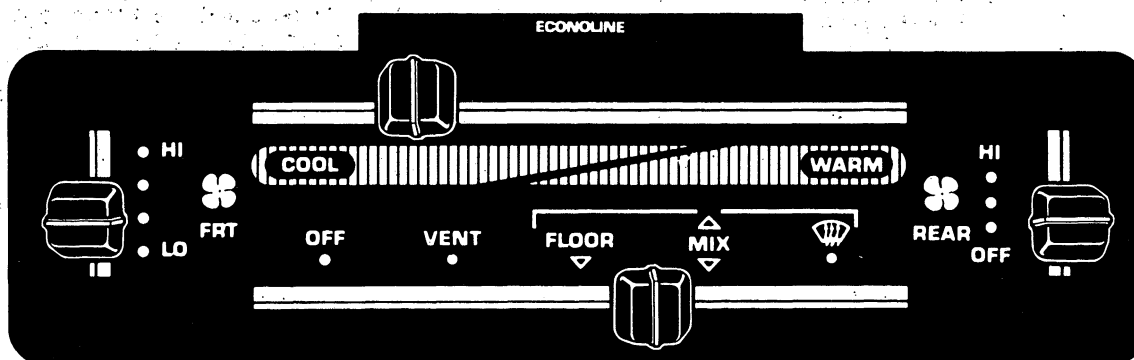
**FIG. 2 Typical Auxiliary A/C-Heater System**





FRONT VIEW OF A/C - HEATER CONTROL ASSEMBLY  
WITH MAIN & AUXILIARY BLOWER SWITCHES

FUNCTION LEVER POSITION	AIR DISCHARGED TO PASSENGER COMPARTMENT	
	MAIN SYSTEM (1)	AUXILIARY SYSTEM (2)
OFF	INACTIVE - NO BLOWER OPERATION	INACTIVE - NO BLOWER OPERATION
MAX A/C	RECIRCULATED AIR TO INSTRUMENT PANEL REGISTERS	RECIRCULATED AIR THROUGH AUXILIARY DUCTS
NORM A/C VENT	OUTSIDE AIR TO INSTRUMENT PANEL REGISTERS	
FLOOR	OUTSIDE AIR TO FLOOR OUTLETS WITH BLEED TO DEFROSTERS	
MIX	OUTSIDE AIR TO FLOOR OUTLETS AND DEFROSTERS	
DEFROST	OUTSIDE AIR TO DEFROSTERS	
NOTES	① TEMPERATURE BLEND DOOR POSITION WILL DETERMINE AIR TEMPERATURE IN ALL FUNCTION SELECTOR LEVER POSITIONS.	② DIRECTION OF AIRFLOW TO REGISTERS, FLOOR OUTLETS OR BOTH DEPENDS UPON POSITION OF AUXILIARY SYSTEM 3-POSITION FUNCTION SELECTOR LEVER.



FRONT VIEW OF HEATER ONLY CONTROL ASSEMBLY  
WITH MAIN & AUXILIARY BLOWER SWITCHES

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FIG. 3 A/C-Heater Control Assembly

rearward position all air is directed through the floor outlets.

### Expansion Valve

The expansion valve automatically regulates the flow of refrigerant into the evaporator, and is the dividing point in the system between high and low pressure refrigerant. Refer to Fig. 5.

The temperature sensing bulb, clamped to the suction (outlet) tube on the evaporator, measures the temperature of the refrigerant in the suction tube and transmits the temperature variation to the expansion valve. This temperature variation regulates the refrigerant (R-12) flow to the core. When the bulb senses a high temperature, the valve opens and floods refrigerant through the evaporator core. When the bulb senses a low temperature, the valve starts closing to shut off the refrigerant to the evaporator core.

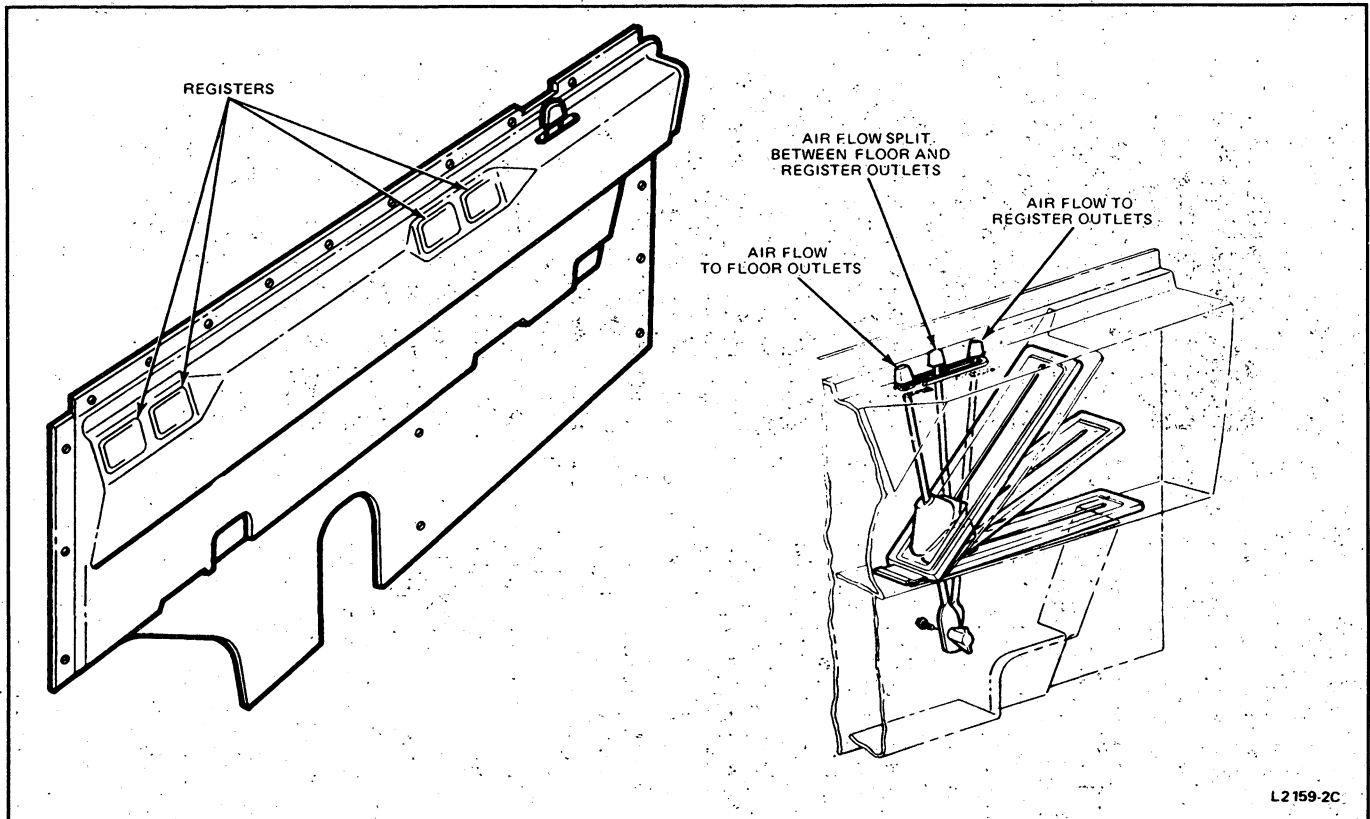


FIG. 4 Auxiliary A/C-Heater Function Selector Lever

### Auxiliary A/C-Heater Cover Assembly

The cover assembly is attached to the body with sixteen screws on both van and club wagon vehicles. On vehicles so equipped, the first bench seat must be removed to service the cover assembly. The auxiliary duct assembly must be installed prior to installing the cover assembly. Refer to Fig. 6.

On vehicles not equipped with an auxiliary A/C-heater duct assembly, a register assembly is attached to the discharge opening as shown in Fig. 7.

To remove the auxiliary A/C-heater duct it is necessary to remove the cover assembly, LH body side window garnish moulding, and the first two bench seats on vehicles so equipped. The duct assembly is attached to the body by fifteen screws on club wagon vehicles, seven screws on van vehicles and four screws on Super Wagon vehicles.

To access the function selector lever and door for service, it is necessary to remove the auxiliary duct assembly from the vehicle, and the duct outer panel from the duct inner panel.

### Registers

The five register assemblies can be adjusted to direct air as desired (Fig. 8). The register louvers can be closed to block most of the airflow. The forward register assembly can be rotated to totally block the airflow. To remove the register, pry on the end pivot with a thin blade to separate the pivot from the pivot hole and pull the barrel assembly from the register housing. The pivot ends of the barrels may have different sizes to control register position when installed.

## DIAGNOSIS AND TESTING

### Blower Motor Voltage Test

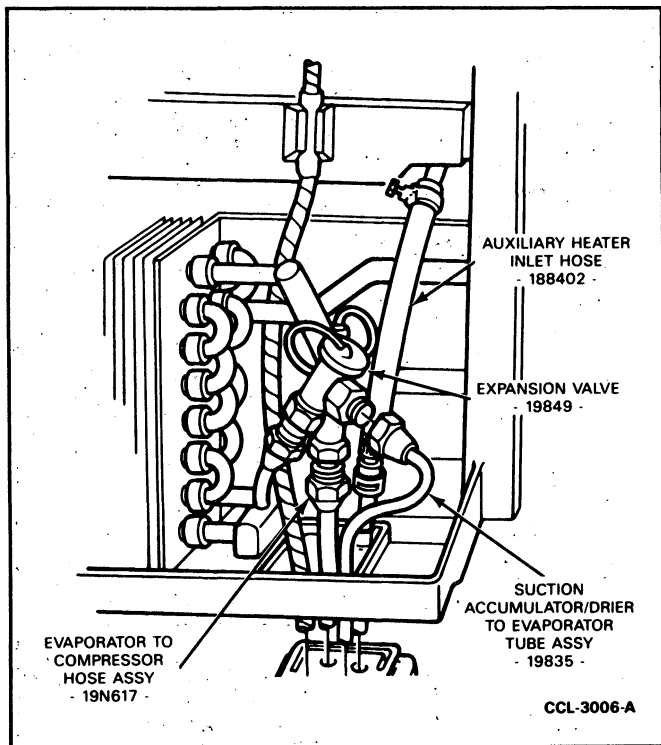
All auxiliary system blower motor electrical circuits use ground side switching to control the blower motor speed. When performing blower motor voltage tests on a system using ground side switching, the voltage reading must be taken at the ground side of the motor (between the motor and the resistor assembly, otherwise the voltage reading will be battery voltage).

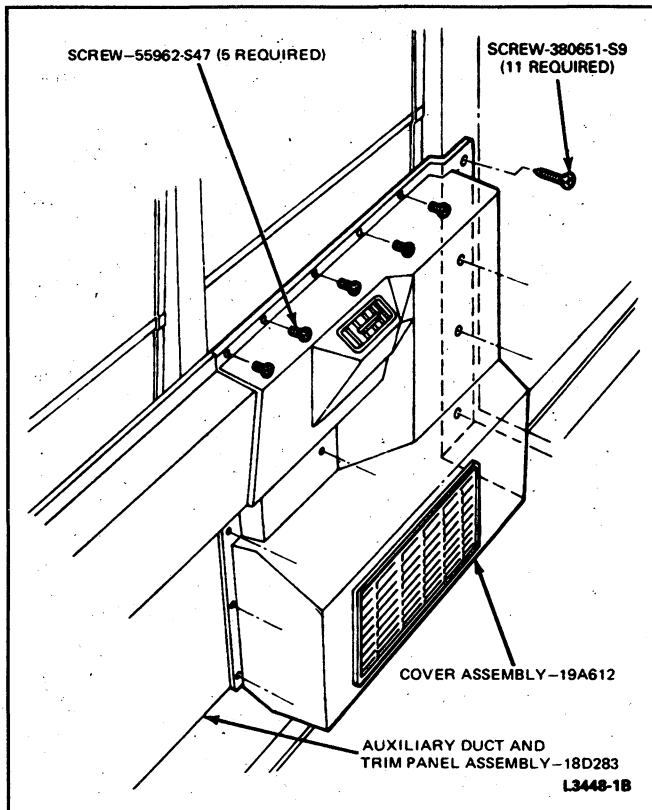
### Test Procedure

1. Insert probes of voltmeter into wire holes of blower motor hardshell connectors and make contact with wire terminals.
2. Measure voltage drop across motor.
3. With engine running (battery voltage approximately 14.2 volts), the voltage reading should be within the range specified for each switch position (Figs. 9 and 11). Connectors for the heater and/or A/C system are shown in Figs. 10 and 12.

### Blower Motor Current Draw Test

1. Separate the blower motor ground (black) wire from blower motor resistor.
2. Connect positive (+) ammeter lead to female spade connector on motor wire, and negative (-) ammeter lead to blower motor resistor.
3. With a fully charged battery, operate blower in each switch position and record current draw (amps). The current draw for each switch position should approximate the values shown in the charts in Figs. 9 and 11.

**FIG. 5 Expansion Valve**



**FIG. 6 Auxiliary System Cover—Removal and Installation**

### Vacuum System Tests

Vacuum is used to control water valve operation. Refer to Section 36-65 E-150—E-350 Air Conditioning System for vacuum system test procedure.

### Refrigerant System

Refer to the refrigerant system tests in Section 36-65 E-150—E-350 Air Conditioning System for refrigerant system diagnosis.

## REMOVAL AND INSTALLATION

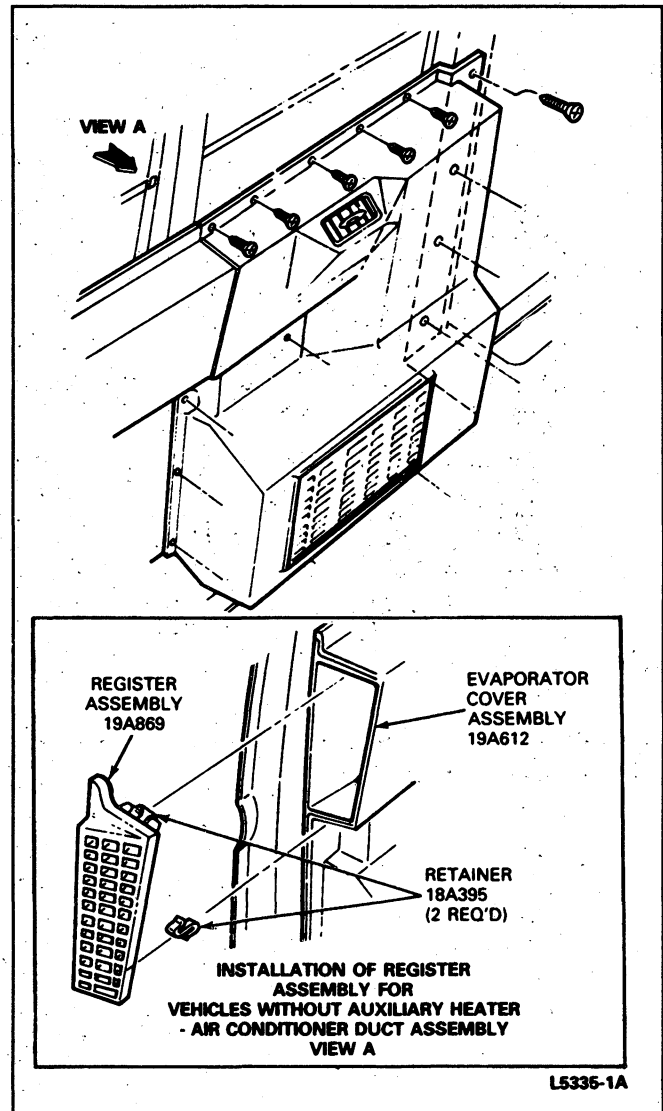
### Auxiliary Heater and/or Air Conditioner Cover Assembly

#### Removal and Installation

1. Remove first bench seat, if so equipped.
2. Remove auxiliary heater and/or air conditioner cover assembly attaching screws and remove cover (Fig. 6).
3. To install, position cover assembly to body side panel and install attaching screws.
4. Install bench seat, if removed. Tighten retaining bolts 34-61 N·m (25-45 ft-lb).

### Auxiliary Duct and Trim Panel Assembly

The installation of the auxiliary duct and trim panel assembly is shown in Fig. 13. The auxiliary heater and/or air conditioner cover assembly must be removed before removing the auxiliary duct and trim panel assembly.



**FIG. 7 Register Assembly—Removal and Installation**

### Auxiliary Duct Assembly

#### Super Club Wagon

To service the auxiliary duct assembly, the auxiliary heater and/or air conditioner cover assembly (Fig. 6), the auxiliary duct and trim panel assembly (Fig. 13) and the rear trim panel must be removed. Refer to Fig. 14 for installation of the auxiliary duct assembly.

### Auxiliary Heater Core and Seal Assembly

#### Removal

1. Remove first bench seat, if so equipped.
2. Remove auxiliary heater and/or air conditioner cover attaching screws (Fig. 6), and remove cover.
3. Remove and discard strap retaining heater core in auxiliary system case.
4. Remove heater hoses from auxiliary heater core (two clamps), and plug hoses with suitable 15.875mm (5/8-inch) plugs.
5. Disengage wire assembly from heater core seal.
6. Slide the heater core and seal assembly out of housing slot. Refer Fig. 15.

**Installation**

1. Position wire assembly to one side and slide heater core and seal assembly into housing slot.
2. Remove plugs from heater hose.
3. Install heater hoses on heater core tubes (two clamps).
4. Fill cooling system to specification and check for coolant leaks. Refer to Section 27-02 for cooling system service procedures.
5. Install a new strap to retain heater core in case assembly.
6. Install auxiliary heater and/or air conditioner cover (Fig. 6).
7. Install bench seat, if so equipped. Tighten retaining bolts to 34-61 N·m (25-45 ft-lb).

**Resistor Assembly****Removal**

1. Remove first bench seat, if so equipped.
2. Remove auxiliary heater and/or air conditioner cover retaining screws and remove cover (fig. 6).
3. Disconnect wiring connectors from resistor assembly (Fig. 15).
4. Remove two resistor retaining screws and remove resistor assembly.

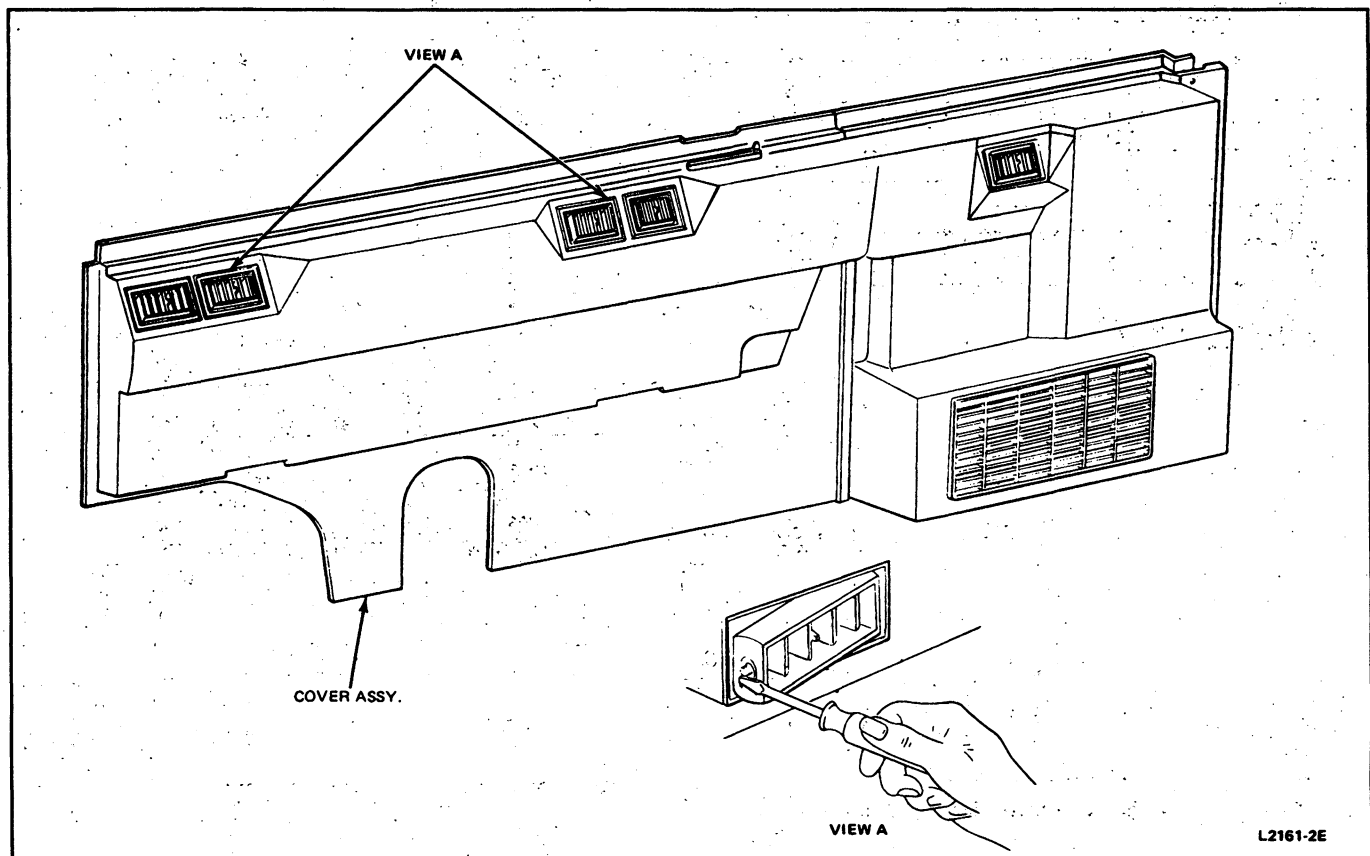
**Installation**

1. Position resistor to housing and install two retaining screws.

2. Connect wiring connectors to resistor assembly (Fig. 15).
3. Hold auxiliary unit cover in place and check operation of blower at each blower speed. **DO NOT** touch resistor during or after operation of blower motor.
4. Install auxiliary heater and/or air conditioner cover (Fig. 6).
5. Install bench seat, if so equipped. Tighten retaining bolts to 34-61 N·m (25-45 ft-lb).

**Auxiliary Heater and/or Air Conditioner Assembly****Removal**

1. Discharge refrigerant from A/C system if an auxiliary A/C is installed.
2. Remove first bench seat, if so equipped.
3. Remove auxiliary heater and/or air conditioner cover retaining screws and remove cover (Fig. 6).
4. Disconnect heater hoses from heater core tubes and plug hoses with suitable 15.875mm (5/8-inch) plugs. Plug heater core tubes to prevent coolant spill during removal.
5. Using a backup wrench to prevent component damage, disconnect liquid line from expansion valve, and suction line from evaporator core (if equipped with auxiliary A/C).
6. Cap lines and fittings to prevent entrance of dirt and moisture into refrigerant system.

**FIG. 8 Registers**



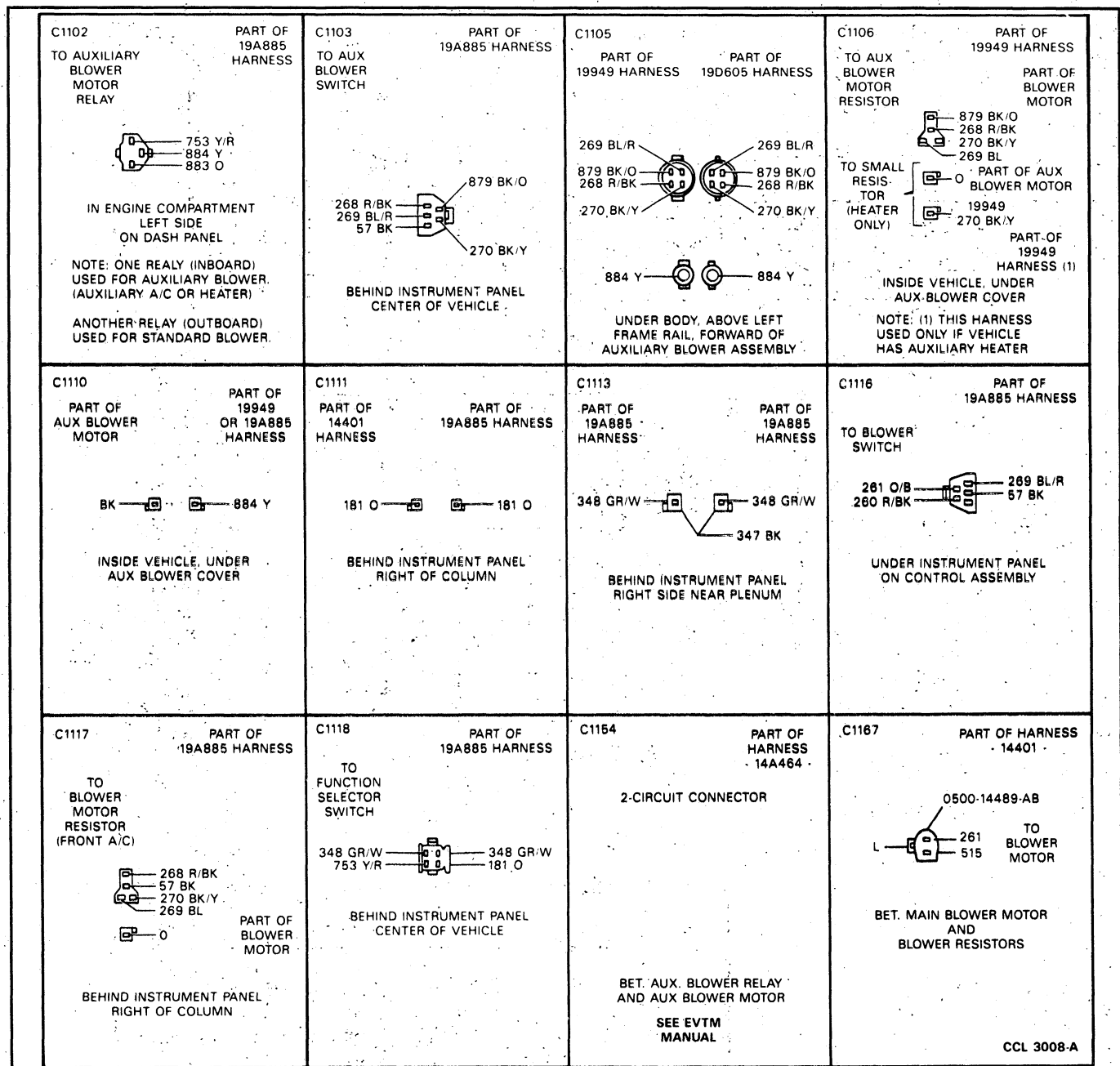


FIG. 10 Main and Auxiliary Blower Wiring Connectors

- Working under vehicle, disconnect blower motor wires at connectors and disengage wiring harness from retaining strap.
- Remove case assembly retaining screws (Fig. 16). Then, lift case assembly, disengage wiring harness grommet from floor seal, and remove case assembly from vehicle.
- Ensure that all seals are in place on bottom of case assembly. Place case assembly near installed position and route wire harness through floor seal. Seat harness grommet in floor seal.
- Position case assembly over floor seal, refrigerant lines and heater hoses, and to body side.
- Install case assembly attaching screws (Fig. 16).
- Working under vehicle, route blower motor wires through support strap and connect wires at harness connectors.
- Remove plugs from heater hoses.
- Connect heater hoses to heater core, if equipped with an auxiliary heater. Tighten hose clamps only to 14-20 N·m (12-18 in-lb).
- If equipped with an auxiliary air conditioner, remove caps from refrigerant lines. Then, connect refrigerant lines to expansion valve and evaporator core. Use new O-rings lubricated with clean refrigerant oil. Tighten all fittings using a backup wrench to prevent component damage.
- Fill cooling system to specification and check for coolant leaks (if equipped with an auxiliary heater). Refer to Section 27-02, Cooling System Service.

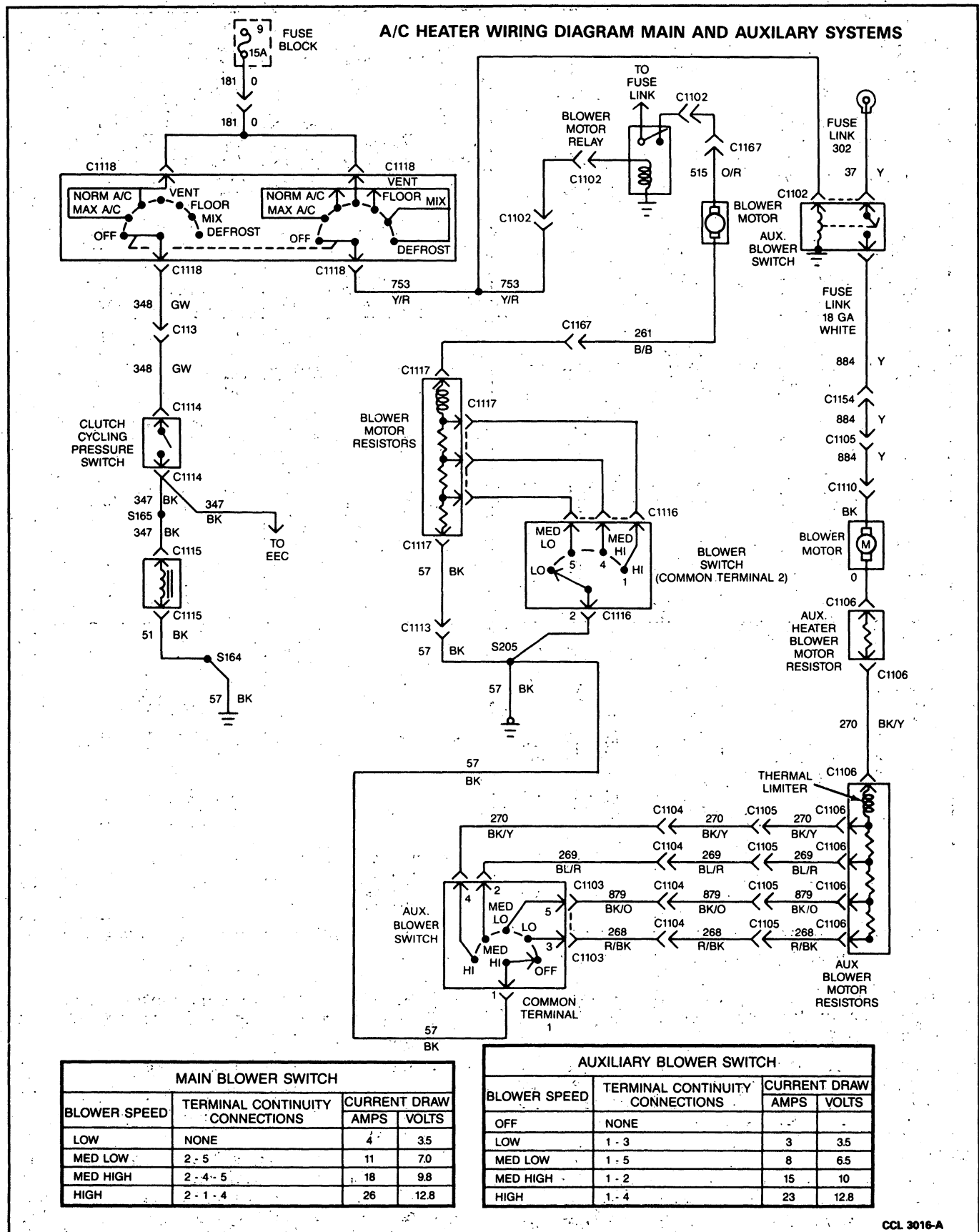
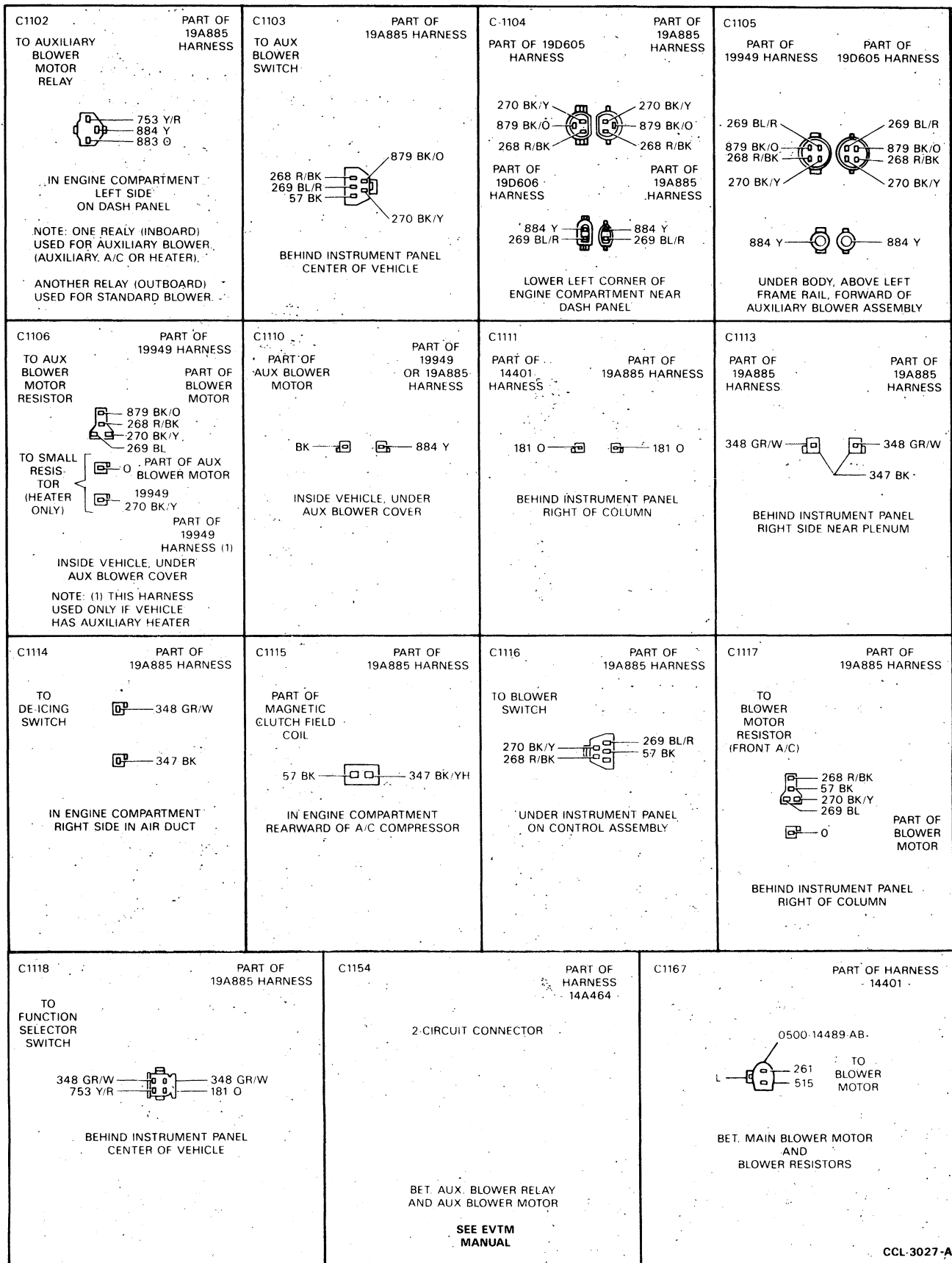


FIG. 11 A/C-Heater Main and Auxiliary Blower Wiring Diagram





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FIG. 12 A/C-Heater Main and Auxiliary Blower Wiring Connectors

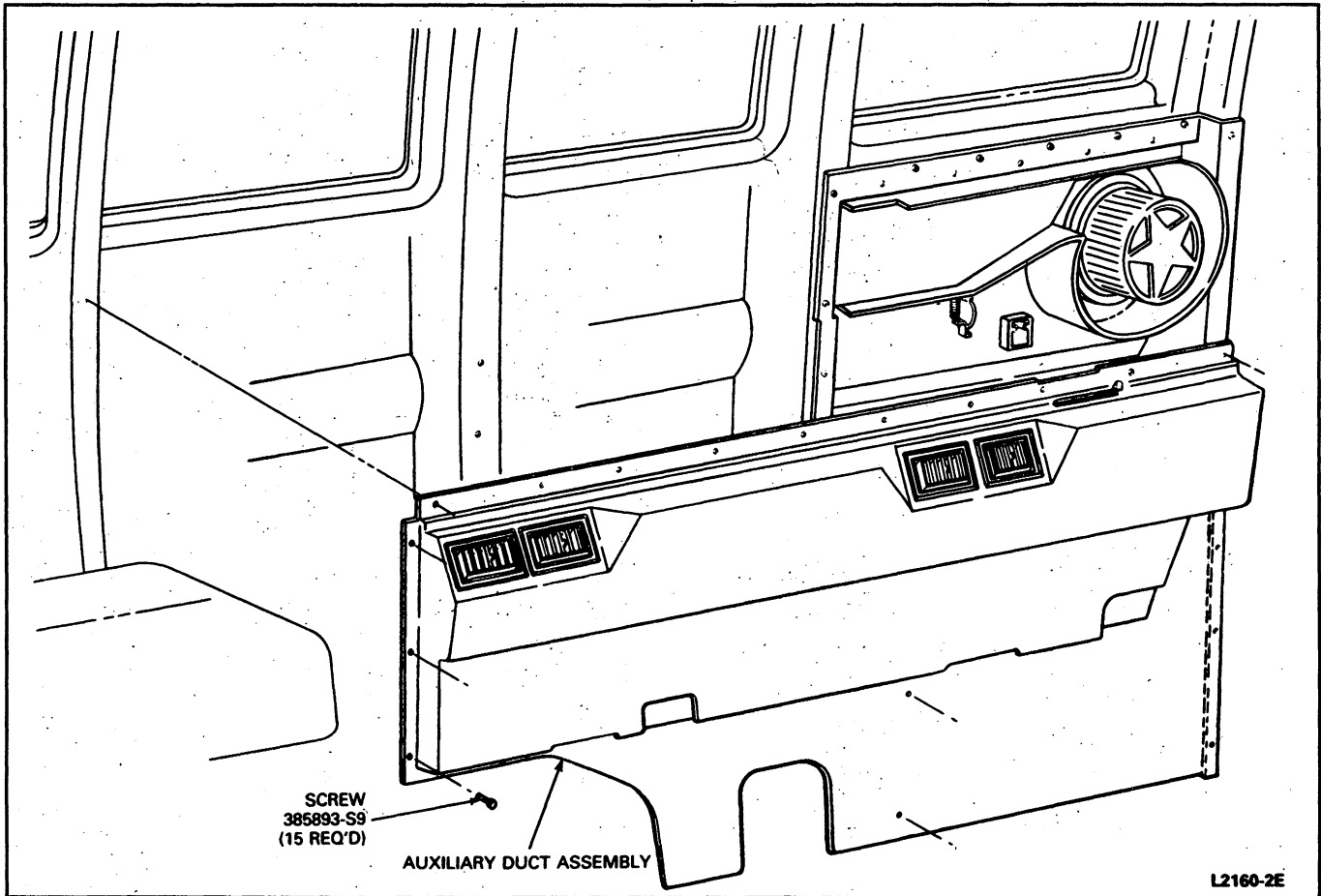


FIG. 13 Auxiliary Duct and Trim Panel Assembly

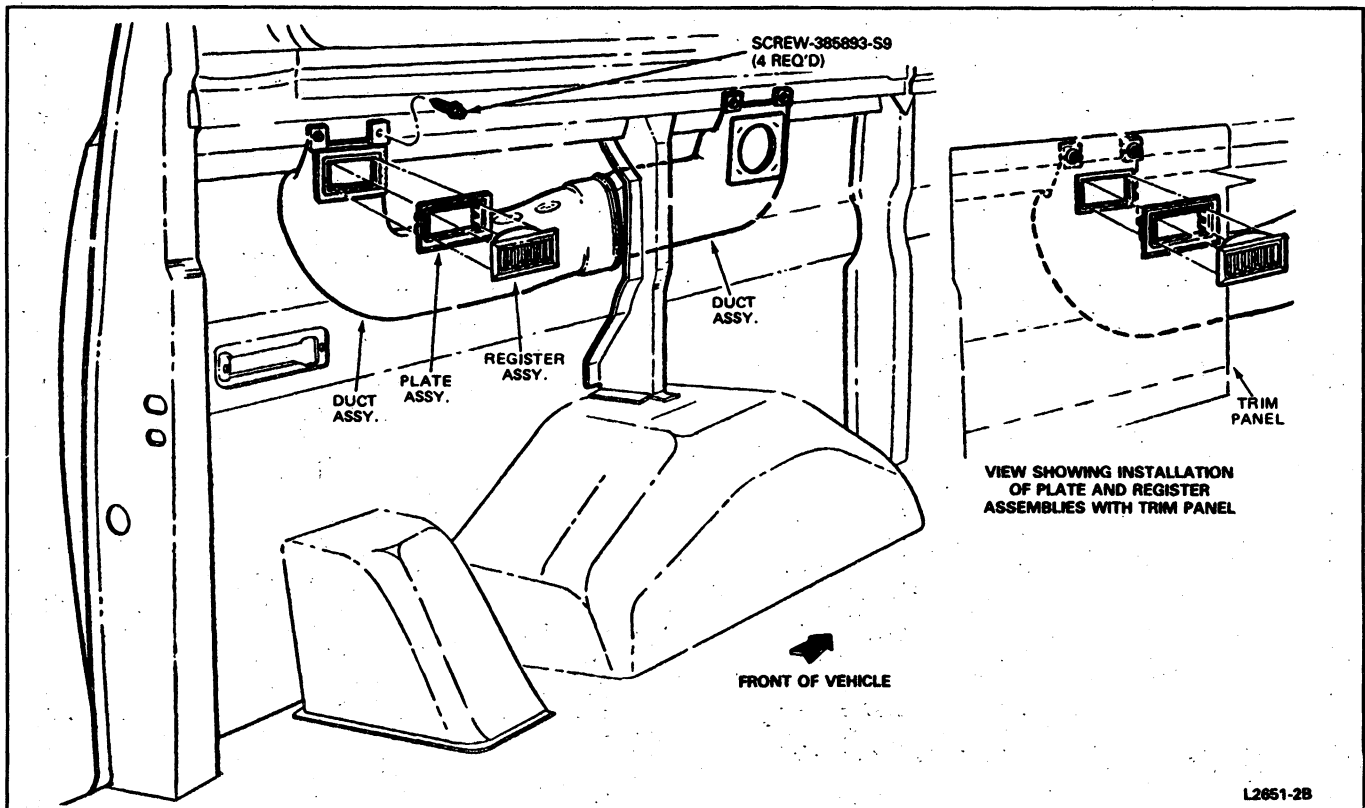
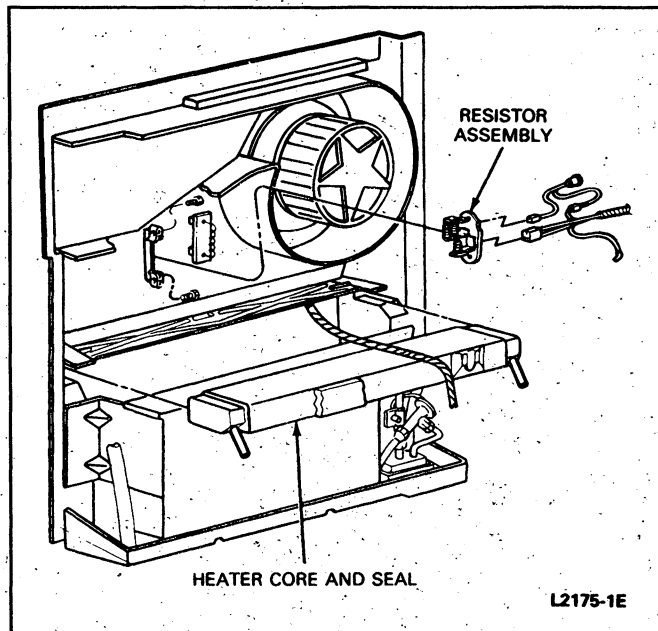


FIG. 14 Super Club Wagon Auxiliary Duct Assembly



**FIG. 15 Heater Core and Resistor**

9. Leak-test, evacuate and charge refrigerant system following recommended procedures, if equipped with auxiliary A/C.
10. Install auxiliary heater and/or air conditioner cover assembly (Fig. 5).
11. Install bench seat, if so equipped. Tighten retaining bolts to 34-61 N·m (25-45 ft-lb).

### Auxiliary Evaporator Core Assembly

#### Removal

NOTE: Whenever a refrigerant line, expansion valve or evaporator core in the auxiliary system is replaced, it will be necessary to replace the suction accumulator drier in the main system.

1. Remove first bench seat, if so equipped.
2. Remove auxiliary heater and/or air conditioner cover assembly retaining screws and remove cover assembly (Fig. 6).
3. Discharge the refrigerant system following recommended service procedures. Observe all safety precautions.
4. Using backup wrenches to prevent component damage, disconnect suction line from evaporator core and liquid line from expansion valve. Cap all open refrigerant line connections to prevent entrance of dirt and moisture.
5. Disconnect heater hoses (if equipped with an auxiliary heater) from auxiliary heater core and plug hoses with suitable 15.875mm (5/8-inch) plugs.
6. Remove four screws retaining evaporator core and mounting bracket to auxiliary case assembly (Fig. 17).
7. Remove evaporator core, expansion valve and core mounting plate from case assembly (Fig. 17).
8. If evaporator core is to be replaced, remove expansion valve and mounting plate from evaporator core.

#### Installation

1. Connect expansion valve to evaporator core inlet tube using a new O-ring lubricated with clean refrigerant oil. Tighten connection to 21-27 N·m (15-20 ft-lb) using a backup wrench to prevent component damage.
2. Clamp the expansion valve capillary bulb to evaporator core outlet tube making sure bulb makes good contact with outlet tube. Clean both surfaces. Wrap capillary bulb and outlet tube with insulating tape, Motorcraft YZ-1 or equivalent.
3. Wrap ends of evaporator core with insulating tape.
4. Attach mounting plate to expansion valve end of evaporator core with two screws.
5. Carefully position evaporator core to case and refrigerant lines. Use new O-rings lubricated with clean refrigerant oil at refrigerant line connections.
6. Tighten refrigerant line connections; suction line to evaporator core 41-47 N·m (30-35 ft-lb), liquid line to expansion valve 14-20 N·m (10-15 ft-lb). Use a backup wrench to prevent component damage.
7. Install four screws that retain evaporator core mounting brackets to evaporator case.
8. Remove plugs from heater hoses.
9. Connect heater hoses to heater core. Tighten hose clamps to 14-20 N·m (12-18 in-lb). DO NOT overtighten hose clamps.
10. Fill radiator to specified level with coolant. Refer to Section 27-02, Cooling System Service.
11. Leak-test, evacuate and charge the refrigerant system following recommended service procedures. Observe all safety precautions.
12. Install auxiliary heater and/or air conditioner cover assembly (Fig. 6).
13. Install bench seat, if so equipped. Tighten retaining bolts 34-61 N·m (25-45 ft-lb).

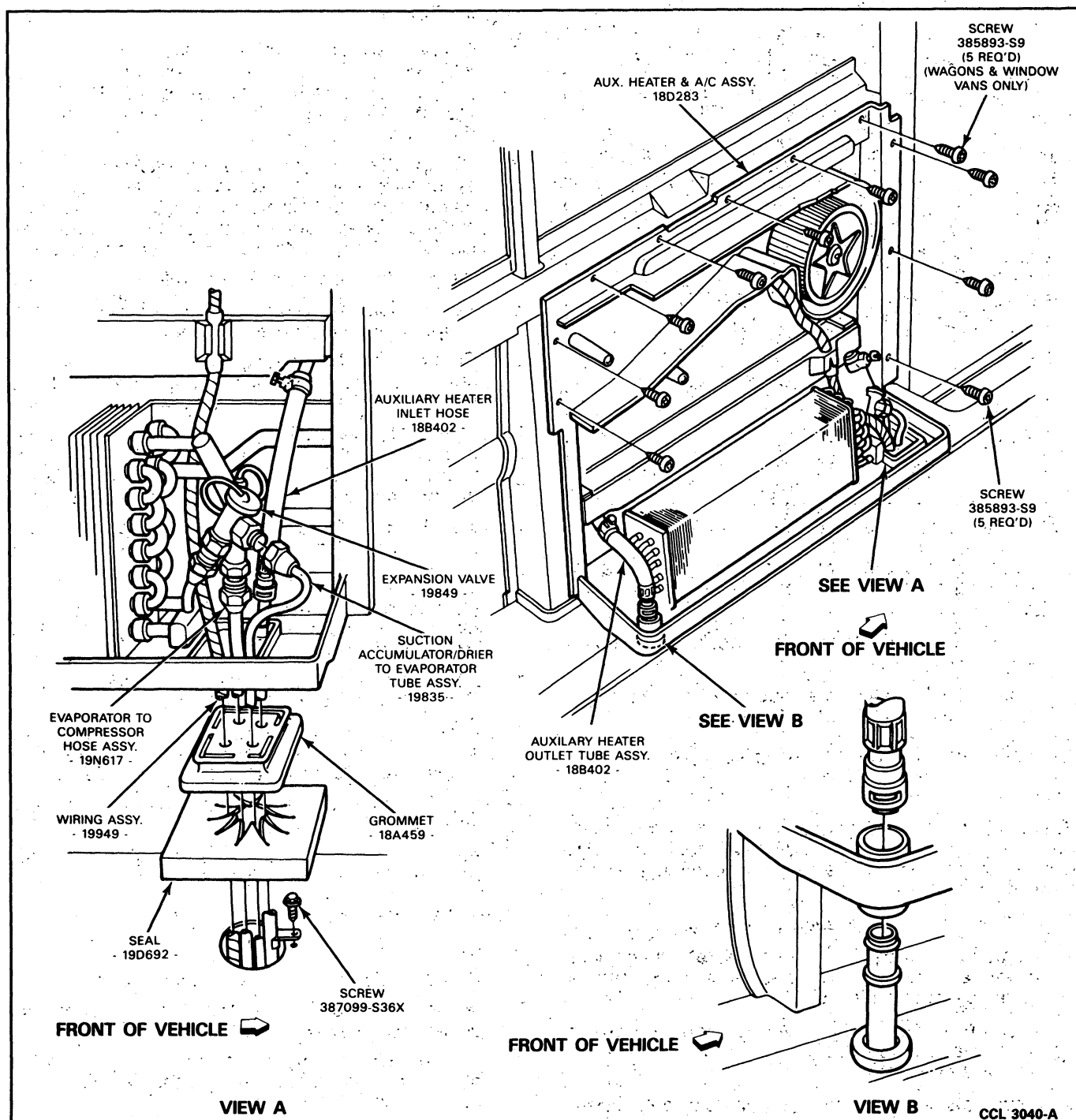
### Expansion Valve

#### Removal

1. Remove first bench seat, if so equipped.
2. Remove auxiliary heater and/or air conditioner cover assembly (Fig. 6).
3. Discharge refrigerant system following recommended procedures. Observe all safety precautions.
4. Disconnect liquid line from expansion valve (Fig. 16). Use a backup wrench to prevent entrance of dirt and moisture.
5. Remove insulating tape from evaporator core outlet tube. Then, remove clamp and expansion valve capillary bulb from outlet tube of evaporator core.
6. Using a backup wrench, remove expansion valve from evaporator core inlet tube. Cap inlet tube if it will be open to atmosphere more than 15 minutes.

#### Installation

1. Connect expansion valve to evaporator core inlet tube using a new O-ring lubricated with clean refrigerant oil. Tighten connection only fingertight at this time.



**FIG. 16 Auxiliary A/C-Heater Assembly**

2. Connect liquid line to expansion valve using a new O-ring lubricated with clean refrigerant oil.
3. Using two wrenches, tighten liquid line to expansion valve fitting to 14-20 N·m (10-15 ft-lb). Tighten expansion valve to evaporator core fitting to 21-27 N·m (15-20 ft-lb).
4. Clamp expansion valve capillary tube bulb to evaporator core outlet tube. Clean both surfaces. Bulb must make good contact with outlet tube.
5. Wrap evaporator core outlet tube and capillary tube bulb with insulating tape.
6. Leak-test, evacuate and charge refrigerant system following recommended procedures. Observe all safety precautions.
7. Install auxiliary heater and/or air conditioner cover assembly (Fig. 6).
8. Install first bench seat, if so equipped.

#### Refrigerant Lines and Heater Hoses

The refrigerant line and heater hose routings for front and auxiliary systems are shown in Figs. 18 through 25.

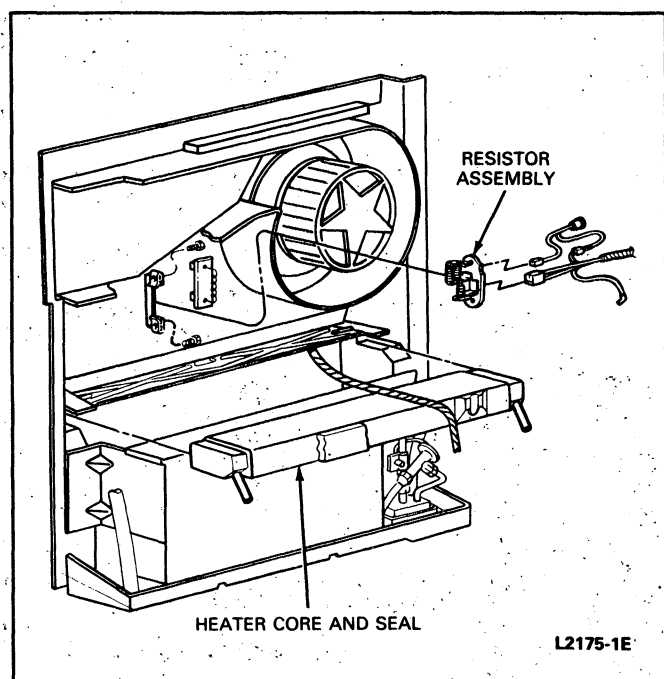


FIG. 17 Evaporator Core Installation

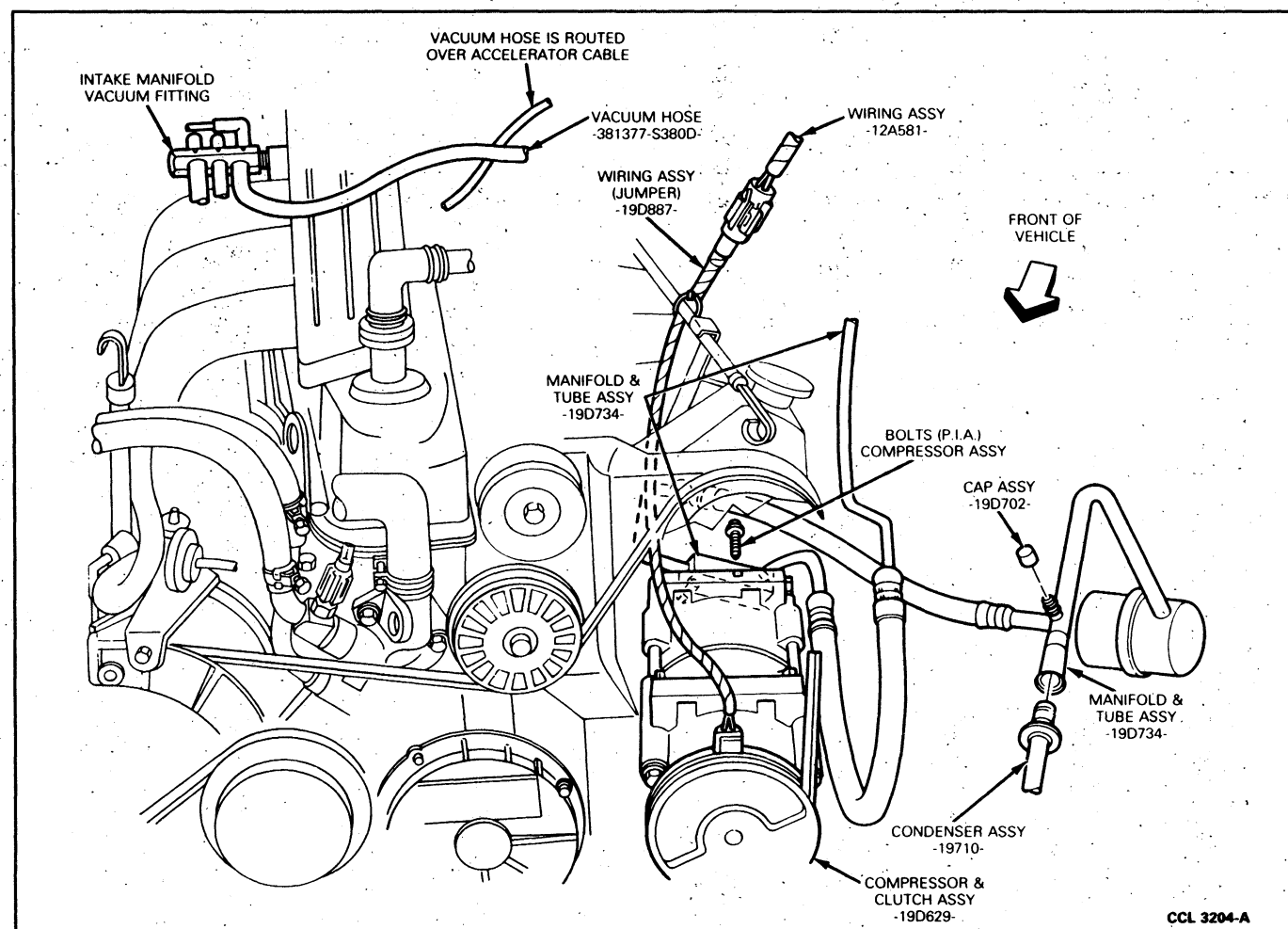


FIG. 18 Main and Auxiliary A/C-Heater System-Lines and Hoses-Engine Compartment-4.9L (300CID) Engine

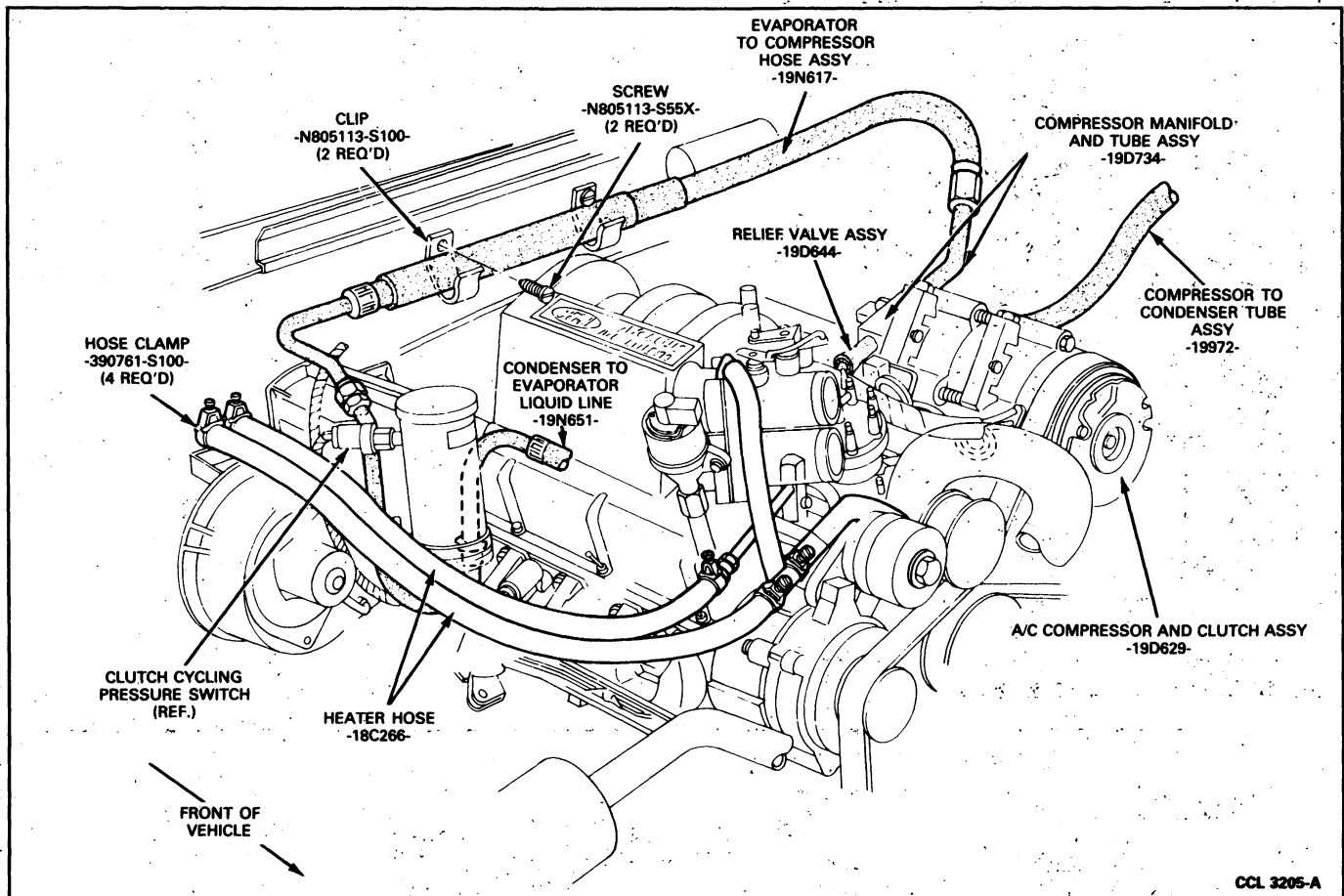


FIG. 19 Main and Auxiliary A/C-Heater System-Lines and Hoses-Engine Compartment -5.0L (302 CID) Engine

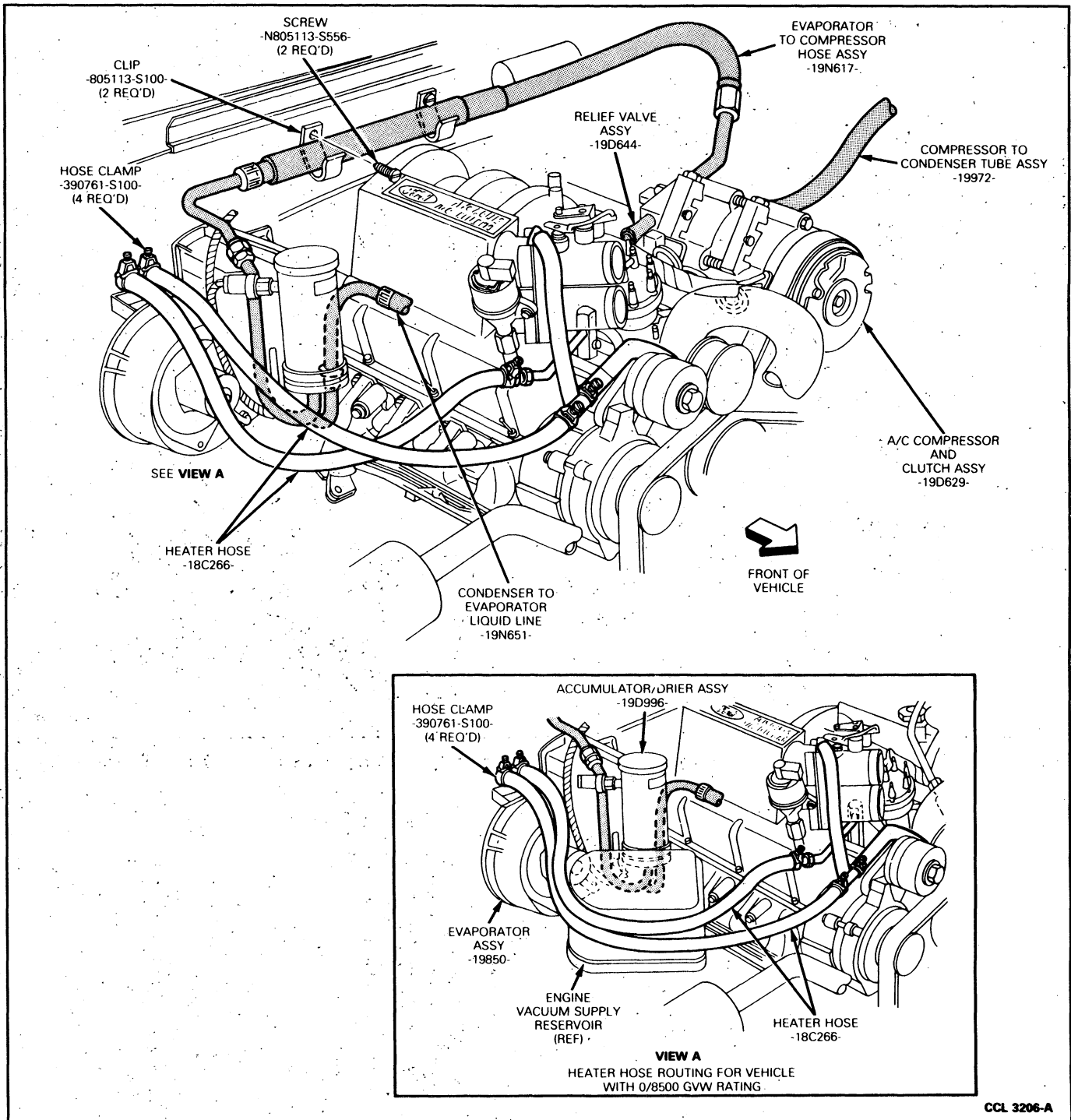
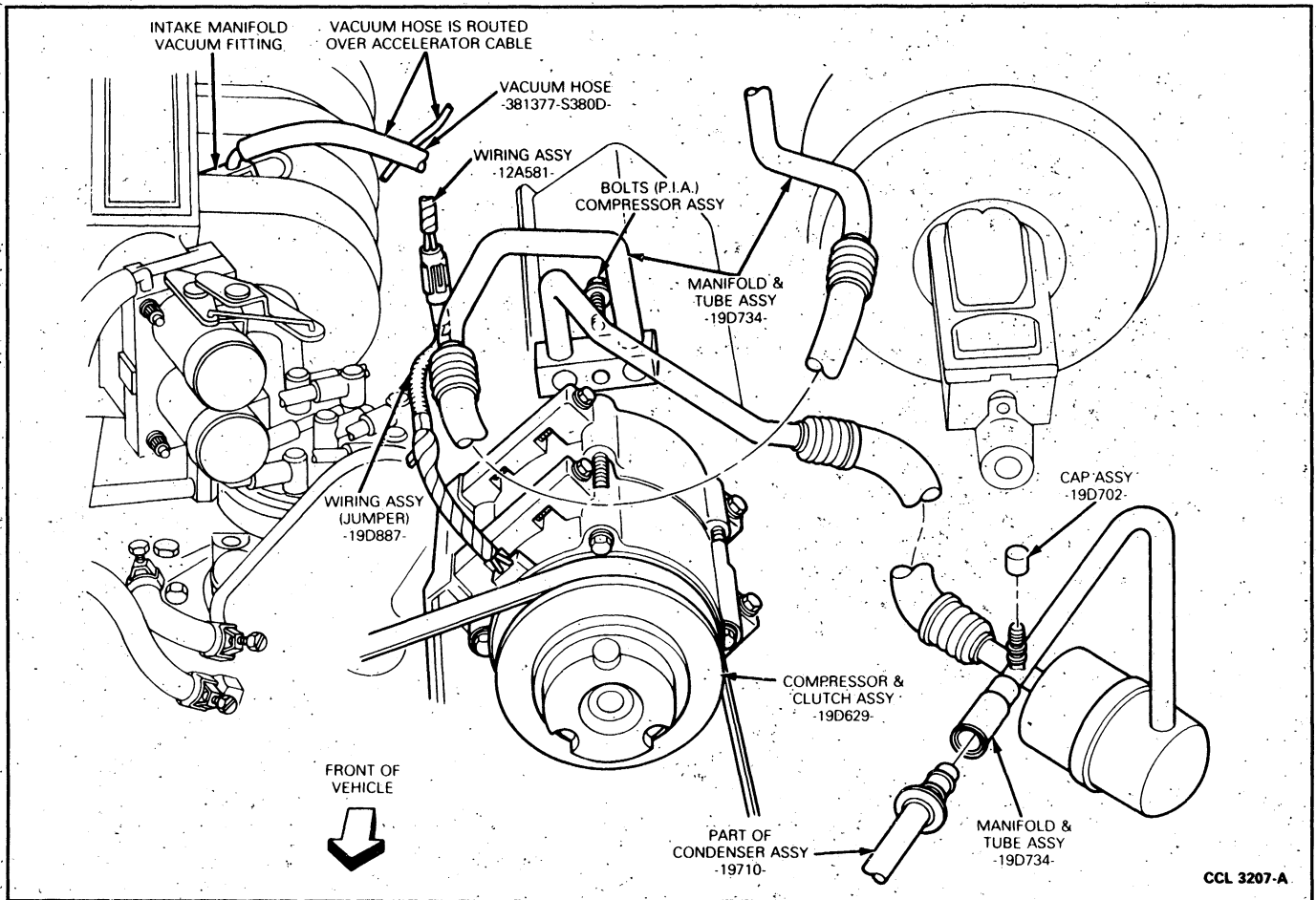


FIG. 20 Main and Auxiliary A/C-Heater System-Lines and Hoses-Engine Compartment 5.8L (351 CID) Engine



**FIG. 21 Main and Auxiliary A/C-Heater System-Lines and Hoses-Engine Compartment 7.3L Diesel Engine**



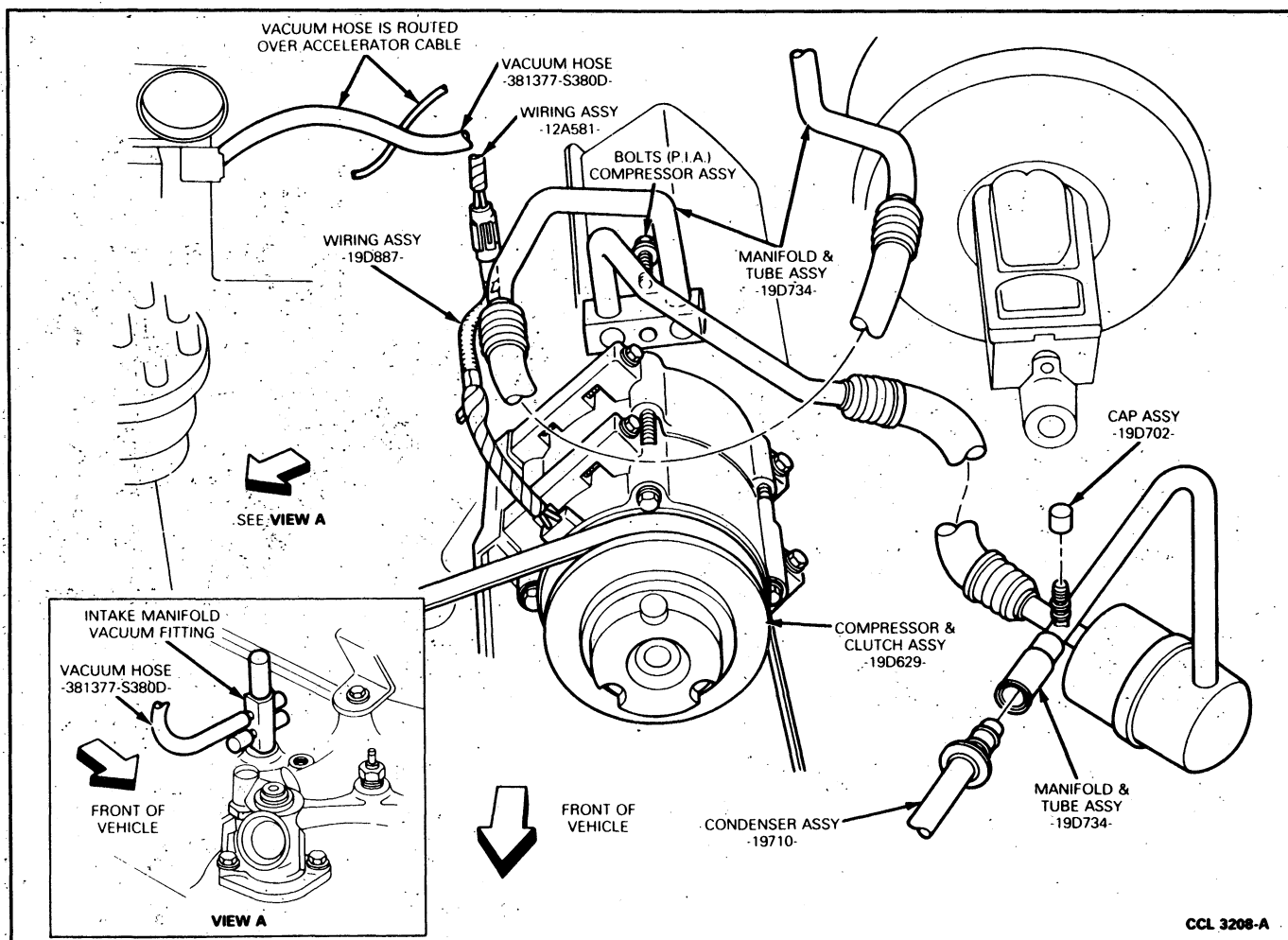


FIG. 22 Main and Auxiliary A/C-Heater System-Lines and Hoses-Engine Compartment-7.5L (460 CID) Engine

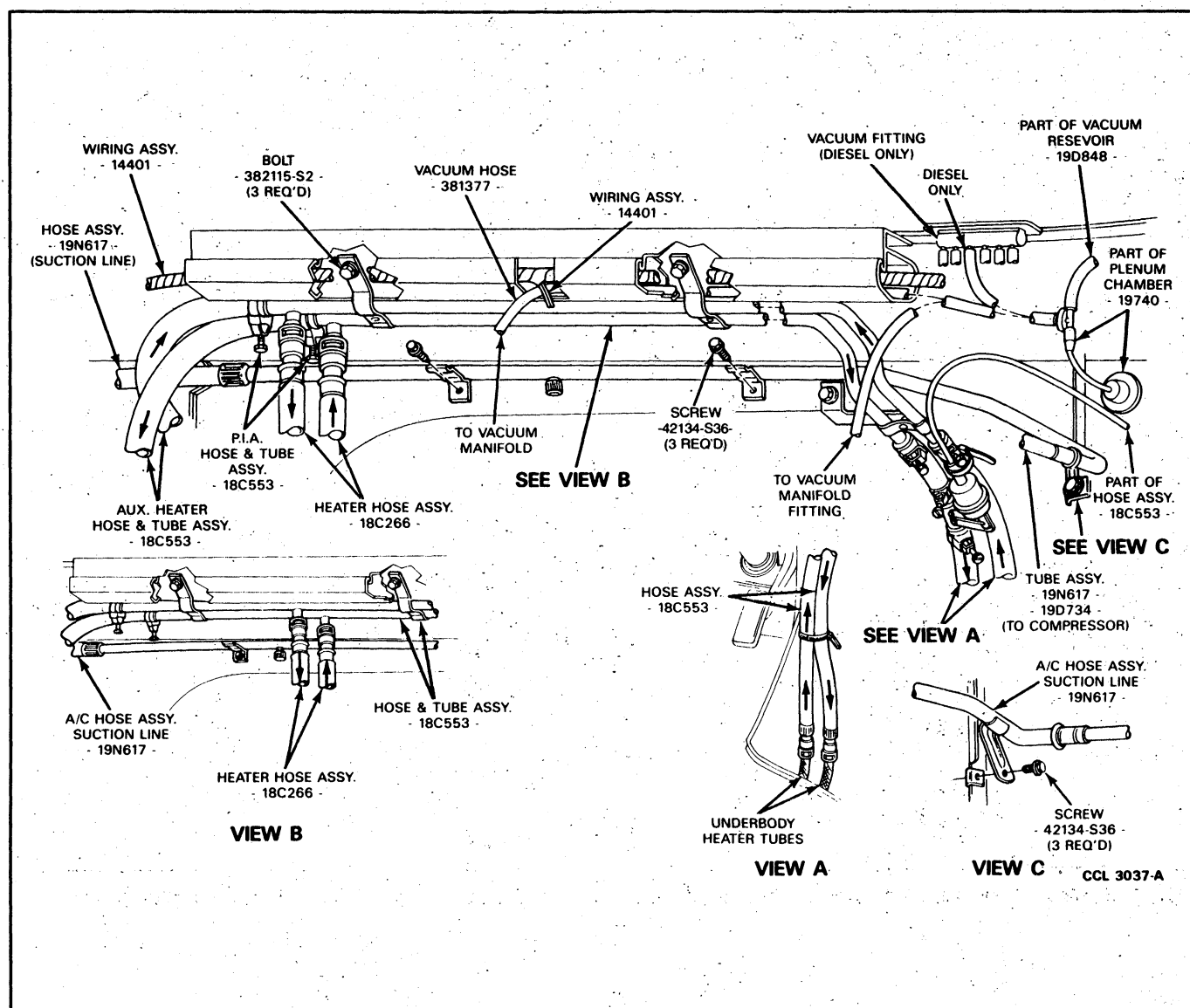
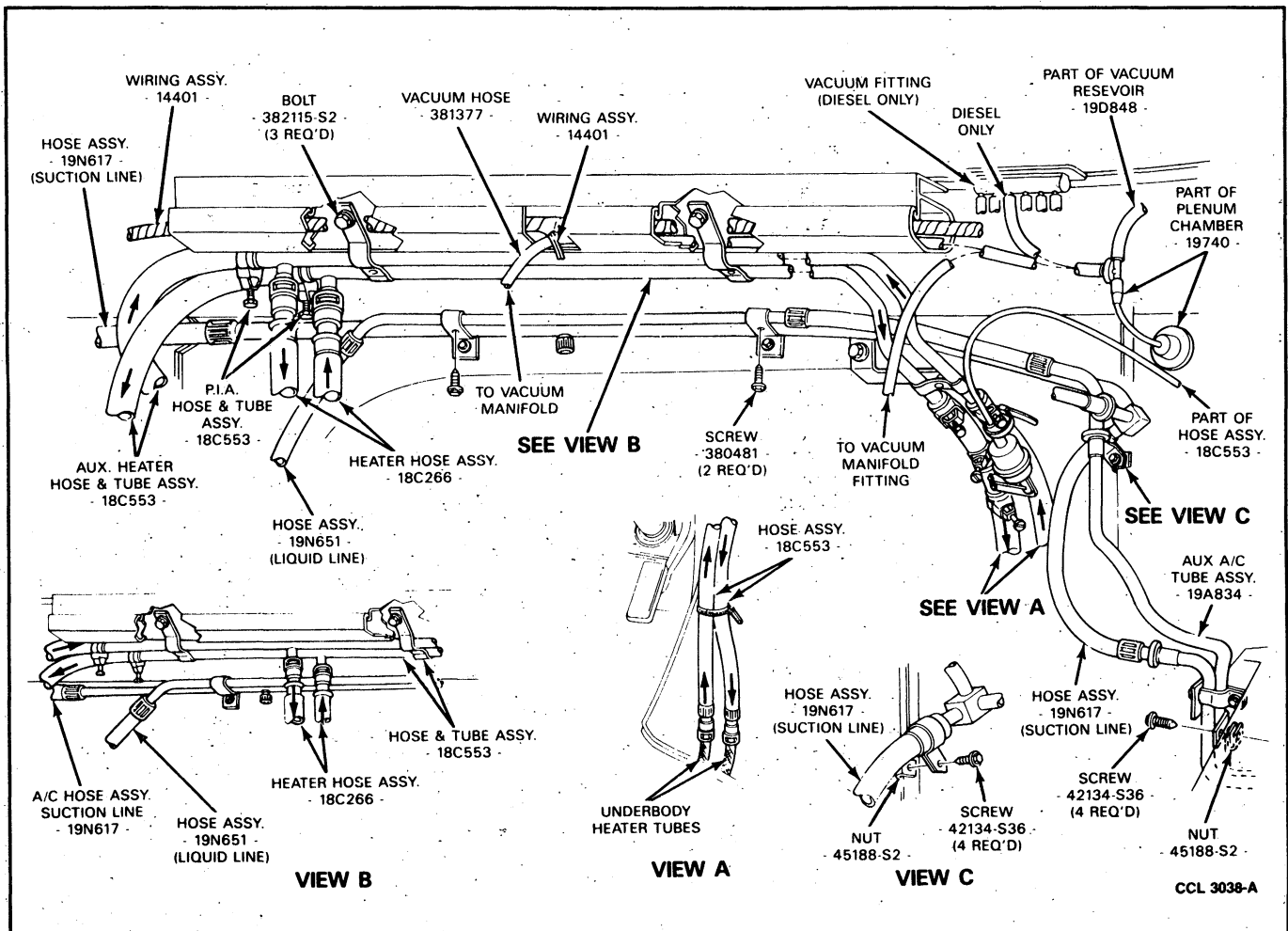


FIG. 23 Typical Hose and Tube Routing and Connections at Dash Panel-Main A/C-Heater and Auxiliary Heater Systems



**FIG. 24 Typical Hose and Tube Routing and Connections at Dash Panel-Main and Auxiliary A/C and Heater Systems**

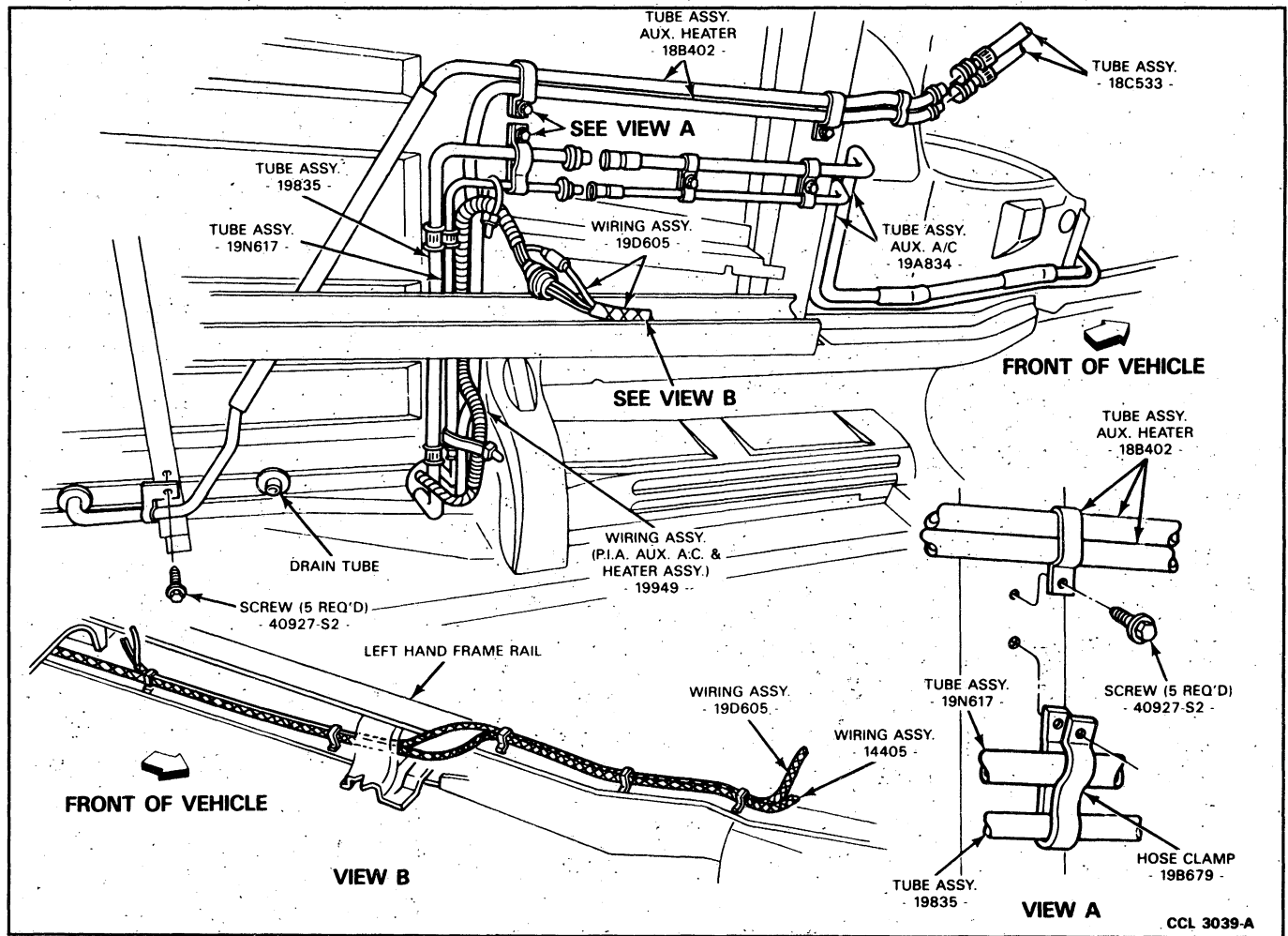


FIG. 25 Typical Underbody Routing of A/C-Heater Hoses and Tubes Between Main and Auxiliary Systems

## SPECIFICATIONS

## ELECTRICAL

System Protection Main System	15 Amp. Fuse (F-9) in Fuse Panel		
Auxiliary System	Fuse Link (Orange) Connected to Starter Relay or Dual Battery Relay		
Blower Motor Current Draw	Blower Speed	Amps.	Volts
Auxiliary System	Low	4.0	4.0
	Med. Low	7.3	6.0
	Med. High	13.8	9.0
	High	23.0	12.8
Clutch Cycling Pressure Switch — Main System Expansion Valve — Auxiliary System			
Illumination Control Assembly			
One 1CP — 161 Bulb			

## REFRIGERANT (A/C ONLY)

Cycling Clutch Control De-Icing Switch	Common with Main A/C System		
System Protection High Pressure Relief Valve	Common with Main A/C System		
Capacity Main (Front) System Only	3½ Lbs. Plus ¼ Lb. Minus 0 56 Oz. Plus 4 Oz. Minus 0 1.588 Kg. Plus 0.113 Kg. Minus 0		
Main (Front) System and Auxiliary System	4½ Lbs. Plus ¼ Lb. Minus 0 68 Oz. Plus 4 Oz. Minus 0 1.928 Kg. Plus 0.113 Kg. Minus 0		
Type Refrigerant 12 (R-12) Ford Spec. Motorcraft Part Number 30 Lb. Container	Dichlorodifluoromethane CCl <sub>2</sub> F <sub>2</sub> ESA-M17B2A YN-7		

## TORQUE SPECIFICATIONS

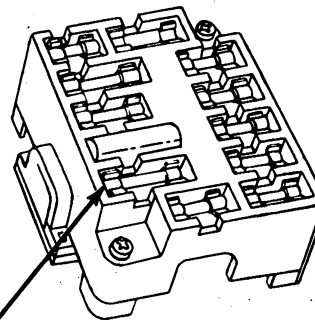
Description	Torque	
	N-m	Ft-Lbs
Expansion Valve to Evaporator Core	21-27	15-20
Liquid Line to Expansion Valve	14-20	10-15
Suction Line to Evaporator Core	41-47	30-35

## COMPRESSOR

10-Cylinder (FX-15) with all gasoline engines  
6-Cylinder (6E171) with all diesel engines

Refer to section 36-36 for FX-15 compressor, 36-37 for 6E171 compressor.

FUSE POSITION 9  
15 AMP FUSE



FUSE POSITION 6  
35 AMP FUSE

CL3447-2G

# SPEED CONTROL

# GROUP 37

(19000)

## SECTION 37-01 Speed Control System

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### VEHICLE APPLICATION

E-150 through E-350, F-150 through F-350 and Bronco.

### DESCRIPTION AND OPERATION

#### Speed Control E-150—E-350, F-150—F-350 and Bronco

The speed control system is comprised of the OFF-ON switch and the SET-ACCL, CST, RSM (ACCEL, COAST, RESUME on Econoline) switches, a servo (throttle actuator) assembly, a speed sensor, a clutch position sensing switch (manual transmissions), an amplifier assembly and the necessary wires, linkage, and vacuum dump valve vacuum hose to connect the components. The 7.3L diesel engine incorporates a

vacuum reservoir with an integrated check valve. The switches are located in the horn pad assembly (Figs. 1, 2 and 3). The amplifier assembly is located under the instrument panel (Figs. 4 and 5). The servo assembly (throttle actuator) is attached as shown in Figs. 10 through 17. The speed control sensor is located on the LH side of the transmission. To operate the speed control system the engine must be running and the vehicle speed over 48 Km/h (30 mph). Manifold vacuum is constantly supplied when the engine is running. When the ON/OFF switch in the steering wheel is momentarily actuated to the **ON position the system is made ready to accept a set speed signal**. When the vehicle has been accelerated and stabilized at a speed over 48 Km/h (30 mph) and the **ON switch engaged, the operator may momentarily depress and release the**

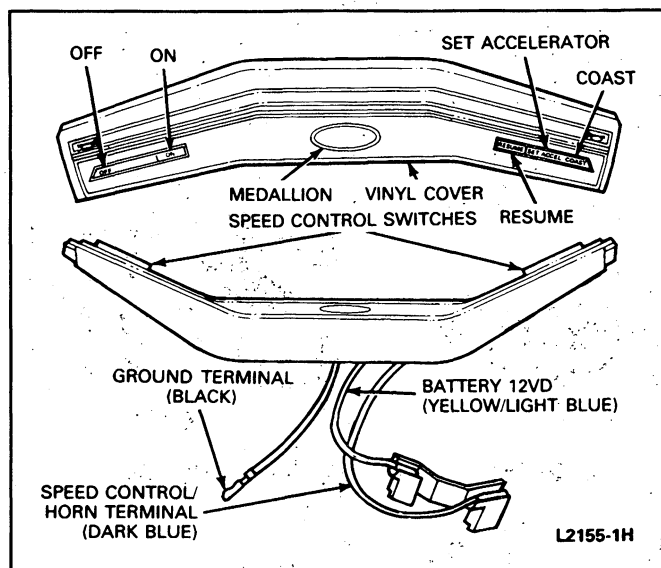


FIG. 1 Control Switch Installation E-150—E-350

**SET/ACCL (ACCEL on Econoline) button.** This speed will be maintained until a new speed is set by the operator, the brake pedal is depressed, the clutch pedal is depressed, the hazard lights are activated or the system or vehicle is turned off.

#### Decreasing Set Speed

The set speed may be reduced by applying the brake and then resetting the speed using the preceding method or by depressing the COAST/CST switch. When the vehicle has slowed to the desired speed the COAST/CST switch is released and the new speed is set automatically. If the vehicle speed is reduced below 48 Km/h (30 mph), the operator must manually increase the speed up to 48 Km/h (30 mph) and reset the system.

#### Increasing Set Speed

The vehicle set speed may be increased at any time by depressing the accelerator until the higher speed is reached and stabilized, then depressing and releasing the SET/ACCEL, ACCL button.

Speed may also be increased by depressing the SET/ACCEL, ACCL switch button, (at speeds over 48 Km/h (30 mph)), and holding it in that position. When the desired speed is attained and the button is released, that new set speed will be maintained.

#### Resume Feature

When the speed control system is deactivated by depressing the brake pedal or clutch pedal or activating the hazard light. The set speed prior to deactivation may be reestablished by momentarily depressing the RESUME/RSM switch. The resume feature is deactivated with the OFF switch, or if the vehicle speed has dropped below 48 Km/h (30 mph). In addition, when the ignition is turned to OFF, the speed control memory is erased and the RESUME/RSM feature will not function.

#### Vacuum Dump Valve

The vacuum dump valve provides a backup safety feature in the new system. Normally, when the brake pedal is depressed an electrical signal from the stoplamp switch to the amplifier will return the system to the stand-by mode. In addition, the vacuum dump valve

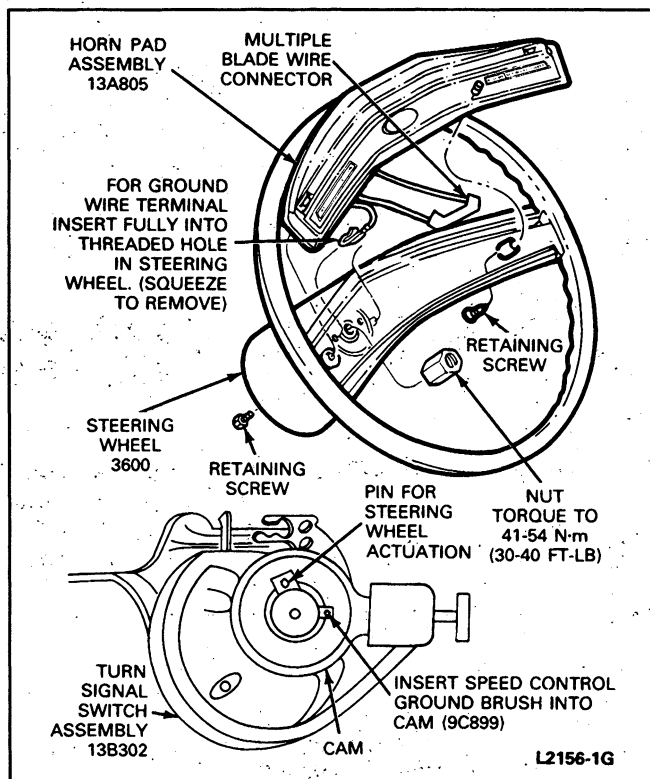


FIG. 2 Horn and Speed Control Switch and Wiring Installation E-150—E-350

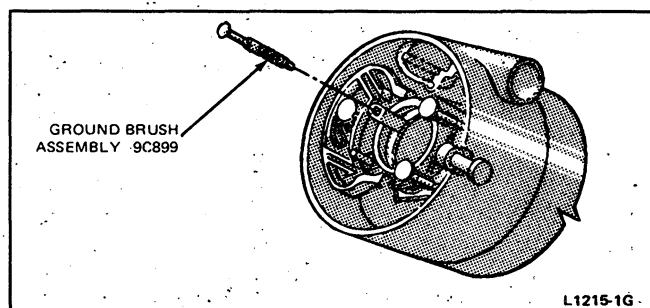


FIG. 3 Ground Brush Installation

will mechanically release the vacuum in the servo while the brake pedal is depressed, thus releasing the throttle independently of the amplifier control.

#### Vacuum Reservoir Assembly (7.3L Diesel Engine)

The vacuum reservoir assembly is provided to supply vacuum to the servo during peak demand. The reservoir is located on the grille support on Econoline (Fig. 14) and on the LH apron near the servo on F-Series (Fig. 19). A check valve is integrated with the reservoir to prevent reverse vacuum flow. There are two 7.9mm (5/16-inch) diameter vacuum ports on the reservoir. The "VAC" port is connected by a 7.9mm (5/16-inch) I.D. vacuum hose to the vacuum source distribution port. The other port is connected by an identical vacuum hose to the speed control servo vacuum source port adjacent to the 6-way electrical connector.

#### Ground Brush

The speed control ground brush assembly provides an electrical ground path between the steering wheel hub and the turn signal switch when inserted into the turn signal canceling cam (Fig. 3).

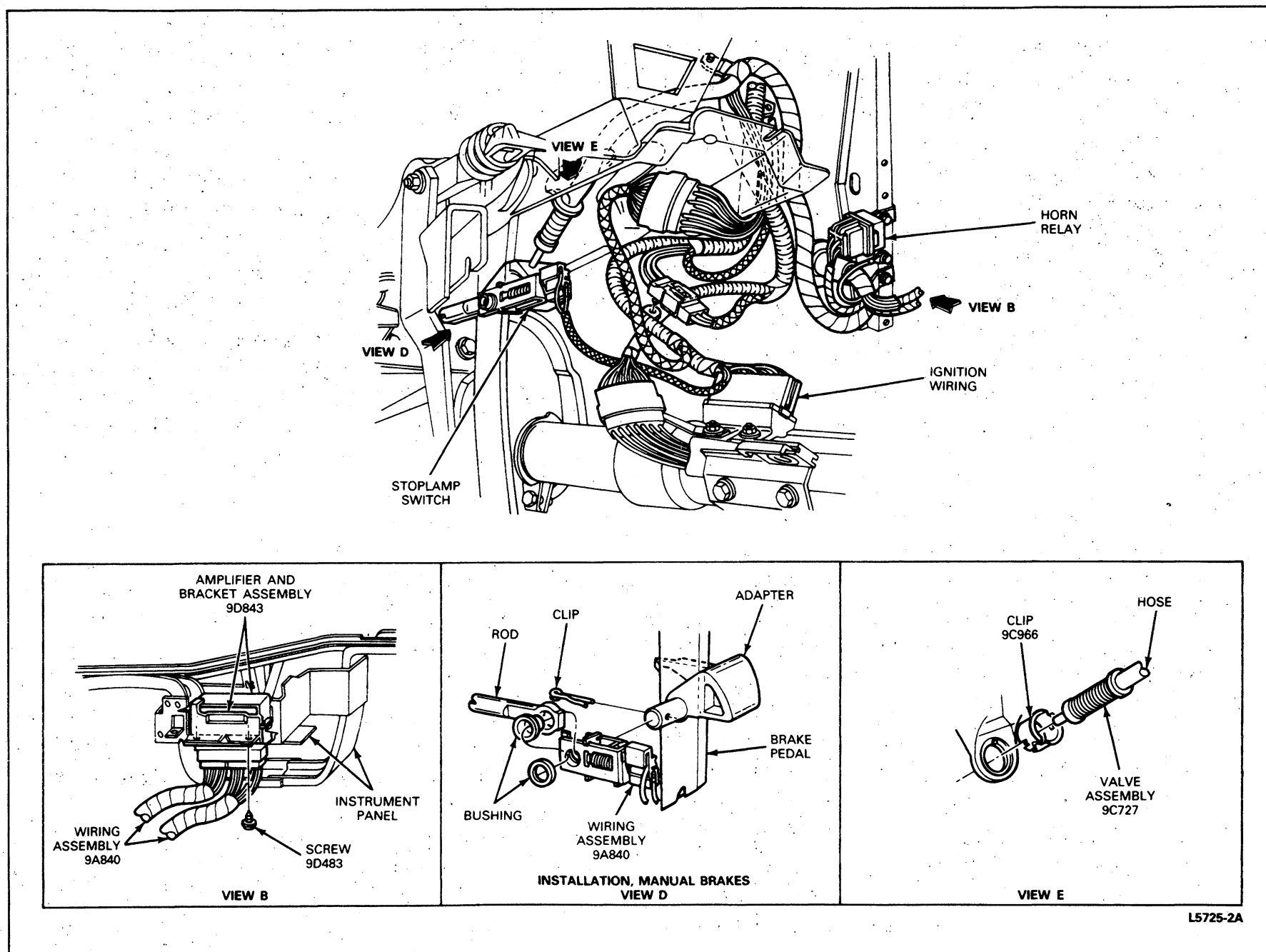
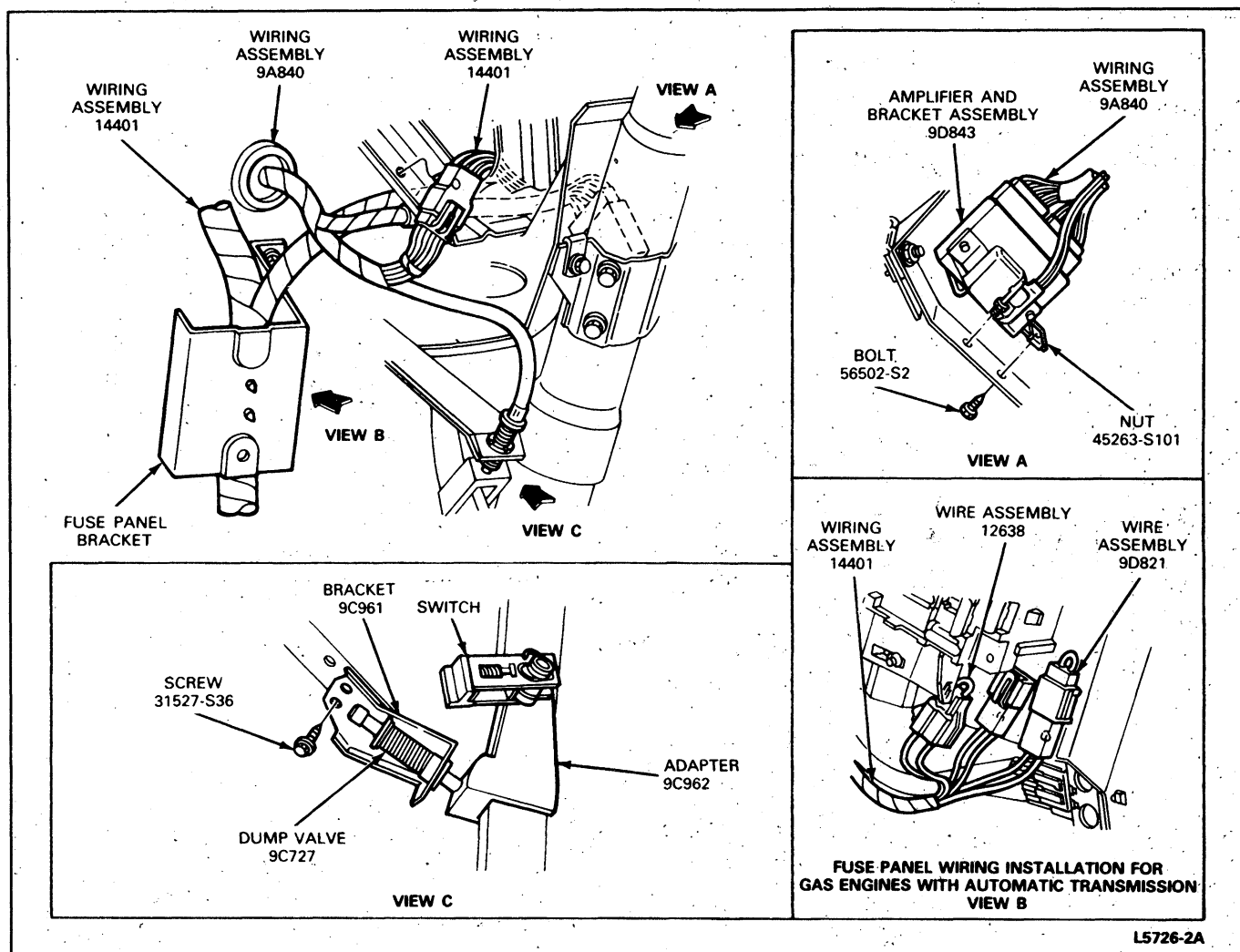


FIG. 4 Speed Control Amplifier and Wiring Installation—All F-Series Vehicles





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FIG. 5 Speed Control Amplifier and Wiring Installation—All E-Series Vehicles

## DIAGNOSIS AND TESTING

Speed control system tests should be performed using the Rotunda Speed Control Tester 007-00013 or equivalent. If the Rotunda Speed Control Tester 007-00013 is not available, use the following procedures.

NOTE: Diagnosis charts are provided at the end of this Section to assist in locating speed control system problems.

### Visual Inspection

A visual inspection is an important part of the system test. When performing a visual inspection, check all items for abnormal conditions such as frayed wires and damaged servo vacuum hoses. For the speed control system to function properly, it is necessary that the speedometer cables be properly routed and securely attached to the components. All vacuum hoses must be securely attached and routed with no sharp bends or kinks. The servo (throttle actuator) and throttle linkage should operate freely and smoothly. **The bead chain, if so equipped, should have no more than 3.18mm (1/8 inch) free play with the throttle set to hot idle position. The actuator cable, if so equipped, should be adjusted as tight as possible without opening the throttle plate or increasing the idle speed. Electrical connections must be complete and tight. The wiring**

**harness must be properly routed. Look for frayed wiring insulation or evidence of shorts.** Any problems revealed by the visual inspection should be corrected before further tests of the speed control system are made.

### Control Switches Test

Disconnect the 6-way connector at the amplifier from the steering column control switches (Fig. 4). Then, check the lead (light blue-black -151) from the control switches as follows:

NOTE: F-150—F-350 Bronco switches are marked SET/ACCL and CST/RSM.

1. Check for battery voltage at the lead (light blue-black) when the ON switch is depressed. Battery voltage should be available at the lead (light blue-black) coming from the control switches. (Refer to the wiring diagram, Figs. 6 through 9.)
2. Connect an ohmmeter such as Rotunda Digital Volt-Ohm-Meter 007-00001 or an equivalent between the light blue-black wire (151) and ground. Check the wire for continuity to ground (0-1 ohm) when the OFF switch is depressed. If a resistance higher than 1 ohm is found, the wiring, slip rings, the copper brushes in the turn signal switch, or the switch is at fault, or the steering column is not

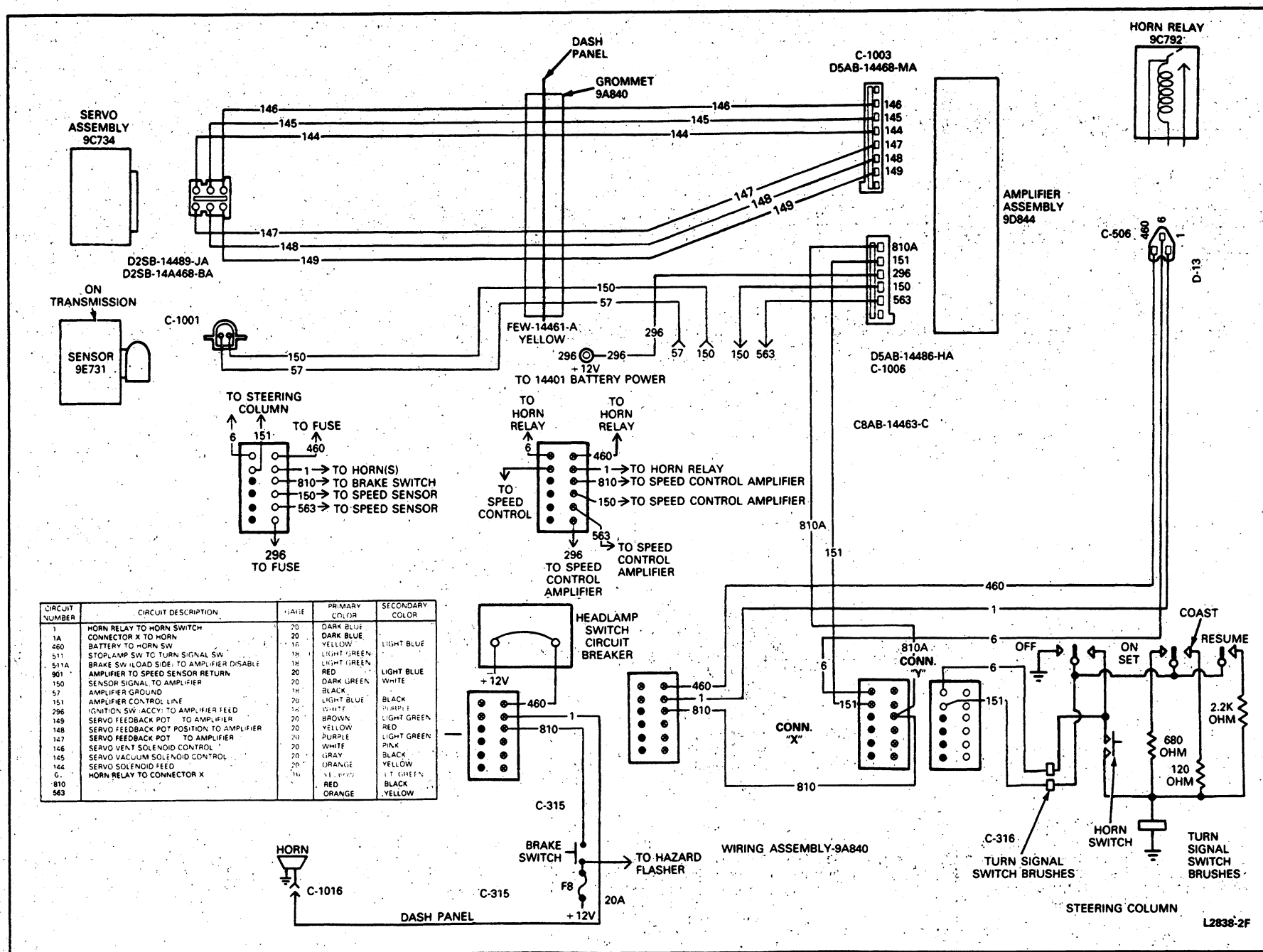


FIG. 6 Wiring Diagram—E-150—E-350

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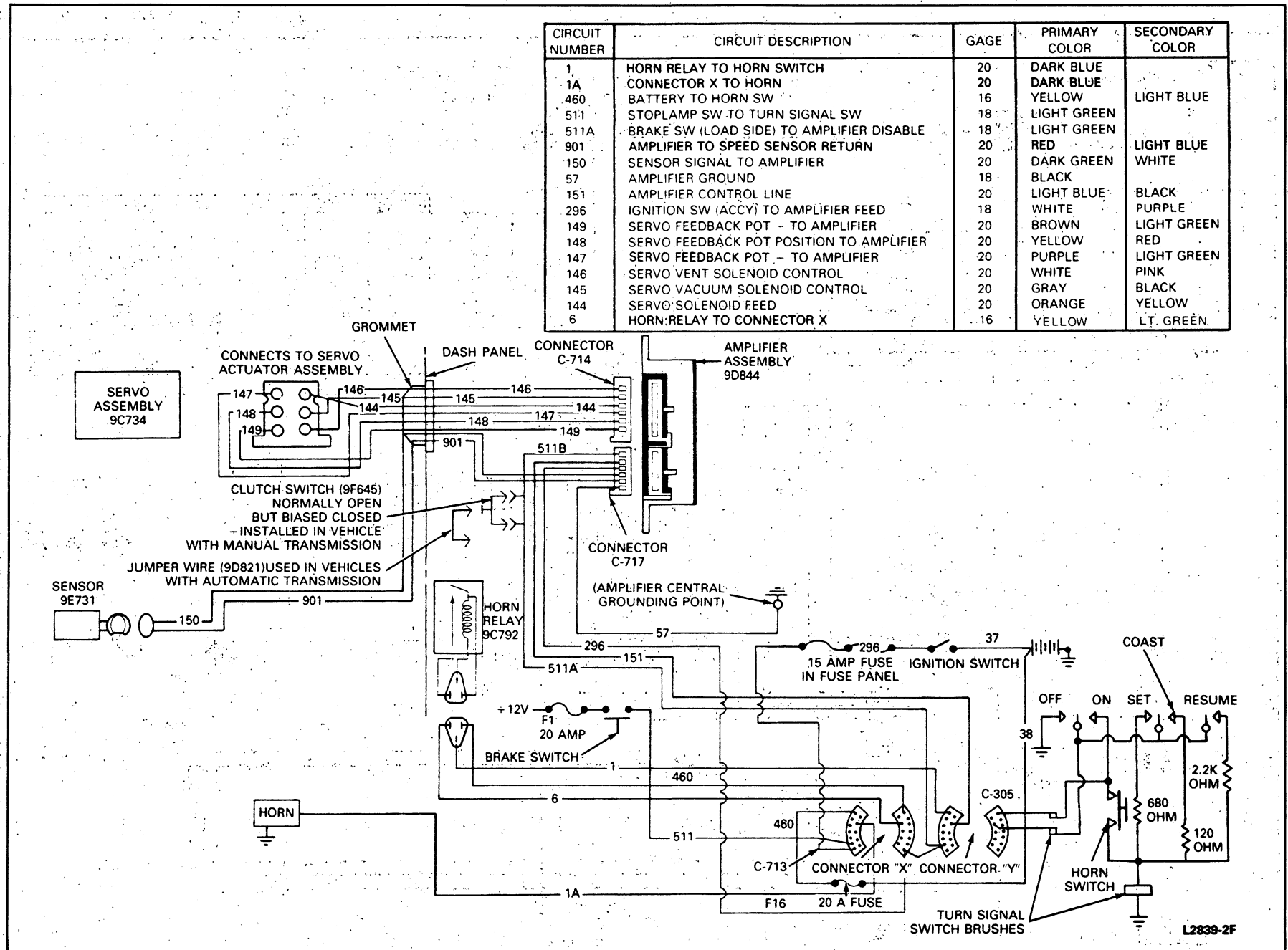


FIG. 7 Wiring Diagram—F-150—F-350 and Bronco



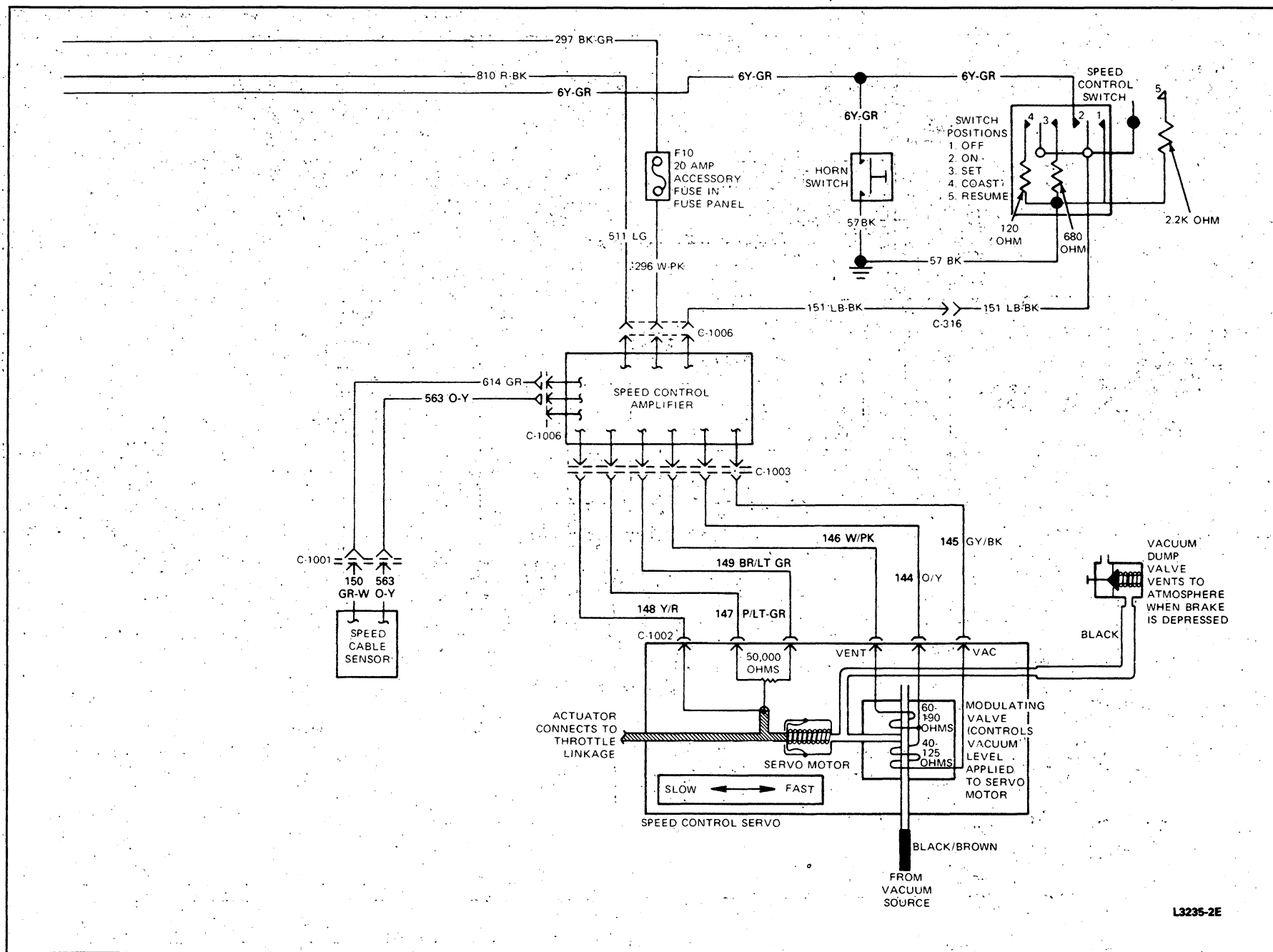


FIG. 9 Main Wiring Diagram—E-150—E-350

properly grounded. To check for proper ground, connect an ohmmeter between any good electrical ground point on the body sheet metal and the steering column upper flange. Scrape away paint in a non-visible spot if necessary for good contact. The resistance should be less than 1/2 ohm. Rotate the steering wheel back and forth and check flexible coupling for resistance of less than 1 ohm. If resistance higher than 3 ohms is noted, clean the horn brush contacts and the ground brush (verify that the ground brush is installed). A resistance of less than 1 ohm must be obtained before performing the remaining tests.

3. With an ohmmeter connected between the light blue-black wire (151) and ground, depress and hold the SET/ACCEL/ACCL switch. A reading of approximately 680 ohms should be indicated on the ohmmeter.
4. With an ohmmeter connected between the light blue-black wire (151) and ground, depress and hold the COAST/CST switch. A reading of approximately 120 ohms should be indicated on the ohmmeter.
5. With an ohmmeter connected between the light blue-black wire (151) and ground, depress and hold the RESUME/RSM switch. A reading of 2200 ohms should be indicated on the ohmmeter.

### Speed Sensor Test

Disconnect the 6-way connector (C-1006 on E-150—E-350 and C-717 on F-150—F-350, Bronco) at the amplifier assembly (Fig. 4), and connect an ohmmeter

between the wire connector terminals (Dark Green-614 and Black-57 on E-150—E-350 and Dark Green—White Stripe-150 and Black-57A on F-150 through F-350 and Bronco) at the speed sensor end. A reading of approximately 200 ohms should be obtained. A reading of zero ohms indicates a shorted coil or wiring harness and a maximum reading indicates an open coil or wiring harness. Replace the sensor in either case.

If the ohmmeter records 200 ohms and the speedometer operates properly within needle waver, the speed sensor is probably good. A speed sensor of known good quality can also be substituted for the existing sensor to check for proper operation.

### Servo Assembly Test

Disconnect the cable from the throttle body, if so equipped (Figs. 11 through 16). Separate connector C-714 at the amplifier. Connect an ohmmeter between the orange-yellow wire 144 and gray-black wire 145 at the 8-way connector. A resistance of approximately 40 to 125 ohms should be obtained. Connect the ohmmeter between the orange-yellow 144 and white-pink wire 146. A resistance of approximately 60 to 90 ohms should be obtained. Reconnect the cable, if so equipped, to the throttle body and properly adjust.

Start the engine, and verify servo vacuum from engine exceeds 2.5 inches Hg (1.22 psi). With the servo disconnected from the amplifier, connect the orange-yellow lead (wire 144) of the servo to the battery positive terminal. Connect the white-pink lead (wire 146) of the servo to ground, and momentarily touch the gray-black lead (wire 145) of the servo to ground. The servo

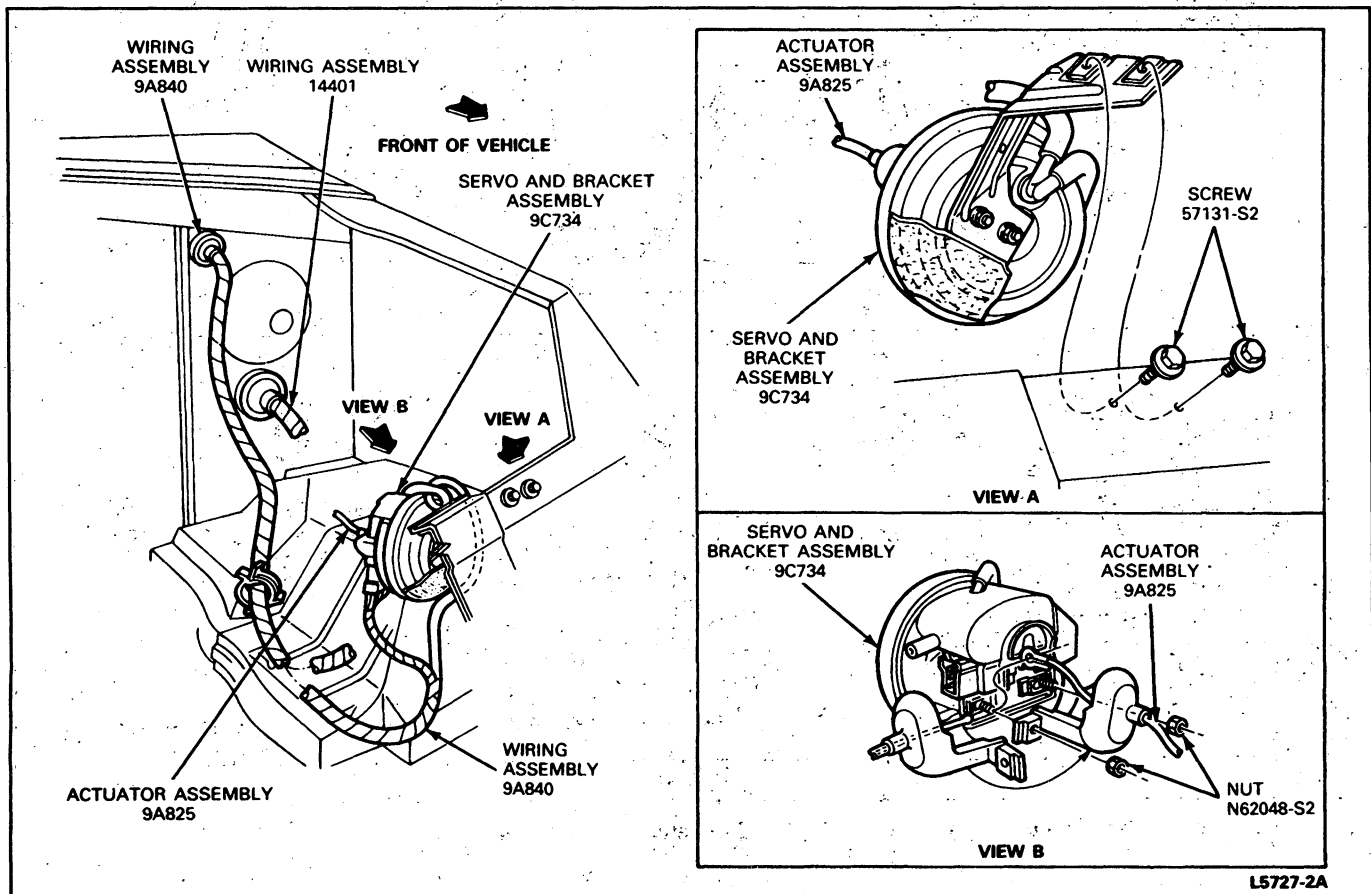


FIG. 10 Servo and Bracket Installation—E-150—E-350

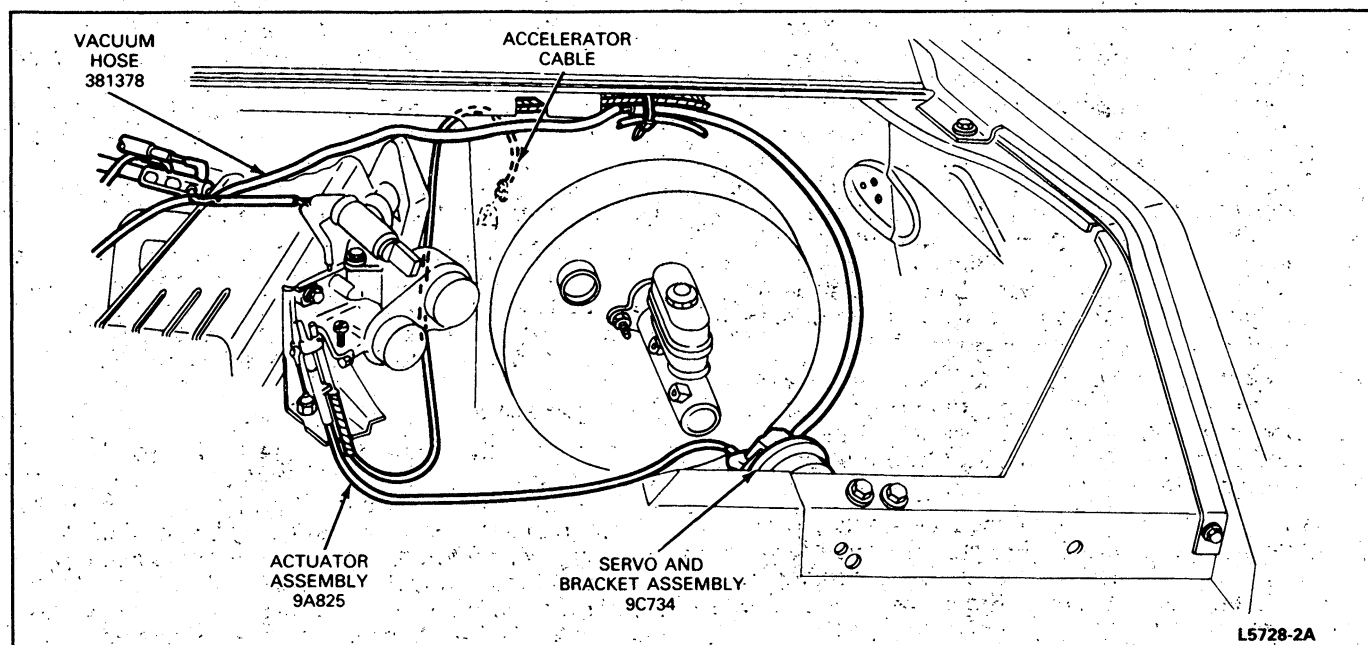


FIG. 11 Servo and Cable Installation—E-150—E-350—4.9L EFI Gasoline Engines

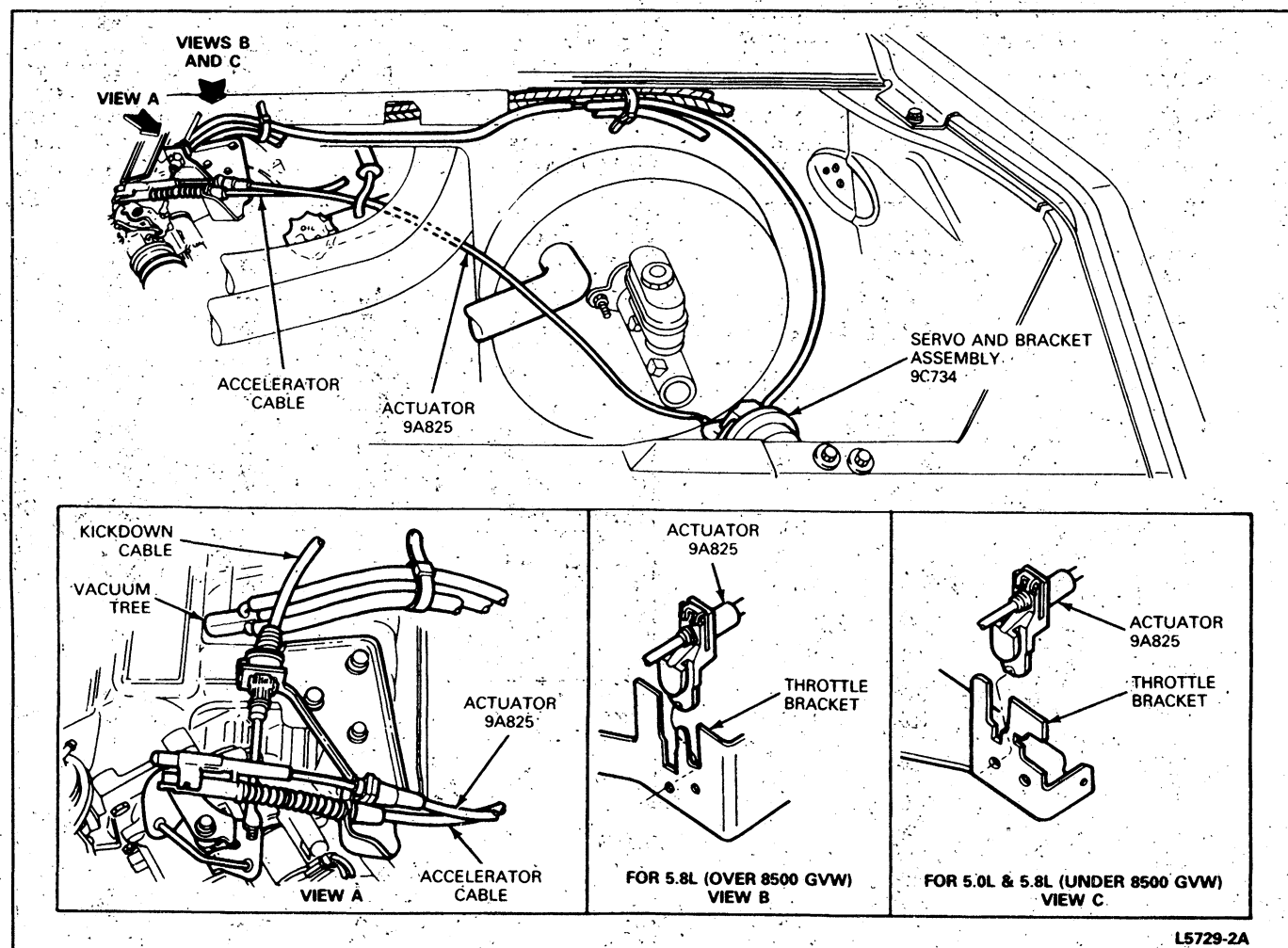


FIG. 12 Servo and Cable Installation—E-150—E-350—5.0L and 5.8L Gasoline Engines

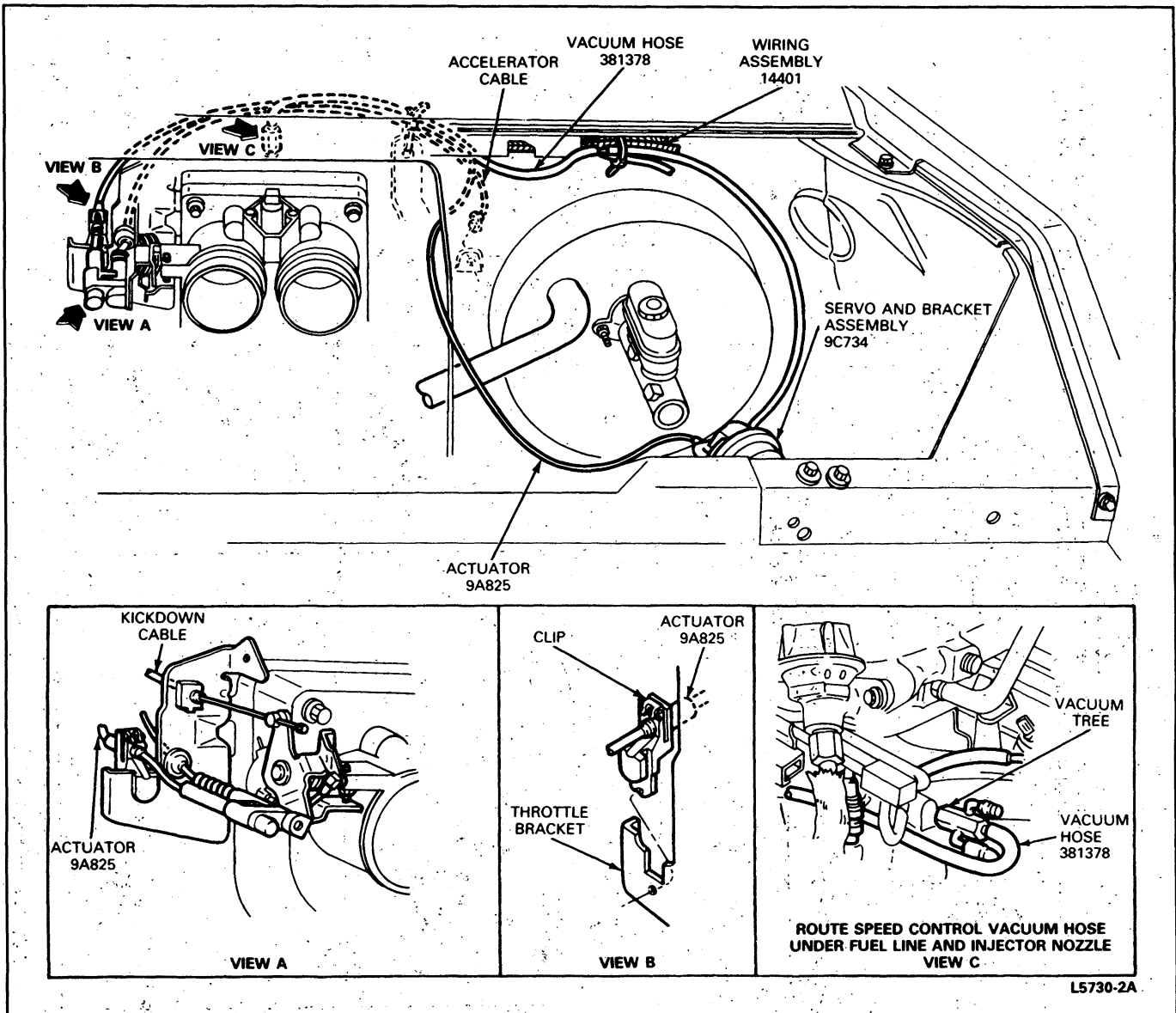


FIG. 13 Servo and Cable Installation—E-150—E-350—7.5L EFI Gasoline Engine

throttle actuator should tighten the actuator cable and open the throttle. The throttle should hold in that position or slowly release the tension. When the white-pink wire is removed from ground, the servo should release actuator cable tension immediately. Replace the servo if it fails any part of the preceding test.

**CAUTION:** If the orange-yellow lead is shorted to either the white pink or gray-black leads, it may be necessary to replace the amplifier.

### Amplifier Test

Do not use a test lamp to perform the following tests as excessive current draw will damage electronic components inside the amplifier. **Use only a voltmeter of 5,000 ohm/volt rating or higher.**

Do not substitute a new amplifier for the old amplifier until the actuator coils have been tested. Refer to the Servo Assembly (Throttle Actuator Test).

### ON Circuit Test

Turn the ignition switch on and connect a voltmeter such as Rotunda Digital Volt-Ohm-Meter 007-00001 or an equivalent between ground and the wire lead (151) (light blue-black) at the amplifier connector (C-717 on F-150—F-350, Bronco and C-1006 on E-150—E-350). The voltmeter should read 12 volts when the ON switch on the steering wheel is depressed and held. If voltage is not available check the horn relay circuit and control switch test. Release the ON button; the voltmeter should read approximately 7.8 volts, indicating the ON circuit is engaged. If the voltage does not remain, check for bad connector 151 or ground contacts to amplifier, fuse and/or circuit breaker and/or hang in a known good amplifier and check for a good ON circuit.

### OFF Circuit Test

With the ignition on and the voltmeter connected between ground and the light blue-black wire (151), depress the OFF switch on the steering wheel. Voltage on the blue wire should drop to zero indicating the ON circuit is de-energized. If the voltage does not drop to



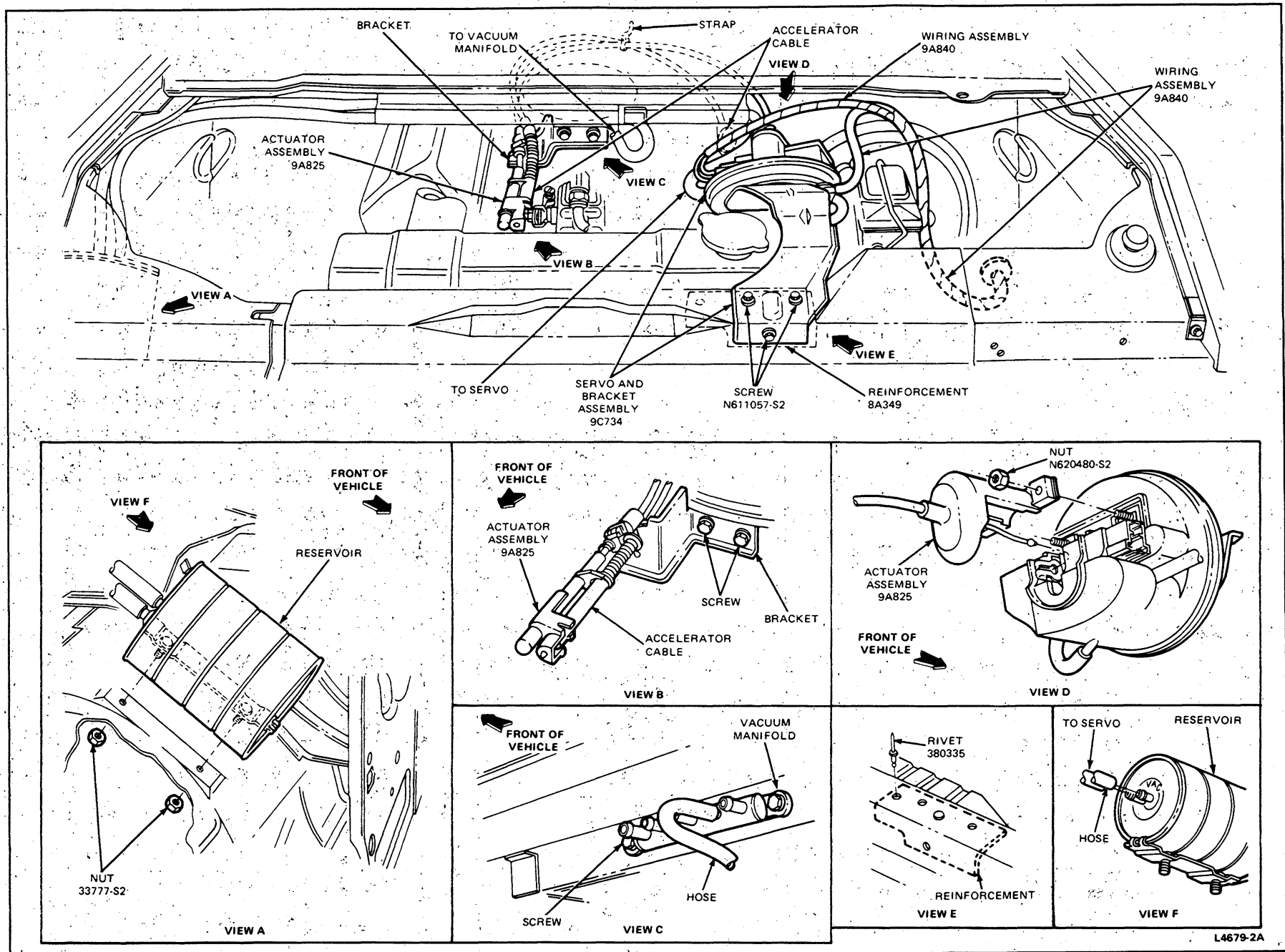


FIG. 14 Servo and Cable Installation—E-250—E-350 with 7.3L Diesel Engine

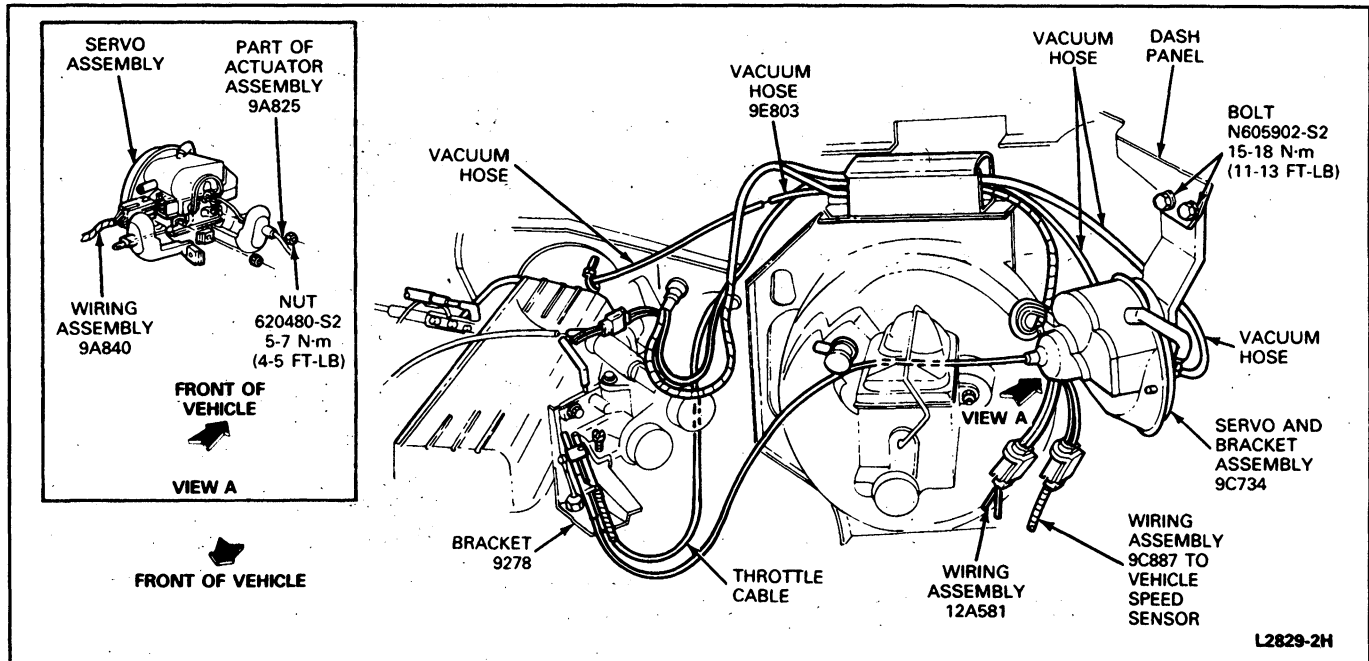


FIG. 15 Servo and Bracket Installation—F-150—F-350 and Bronco 4.9L (300 CID) Engine

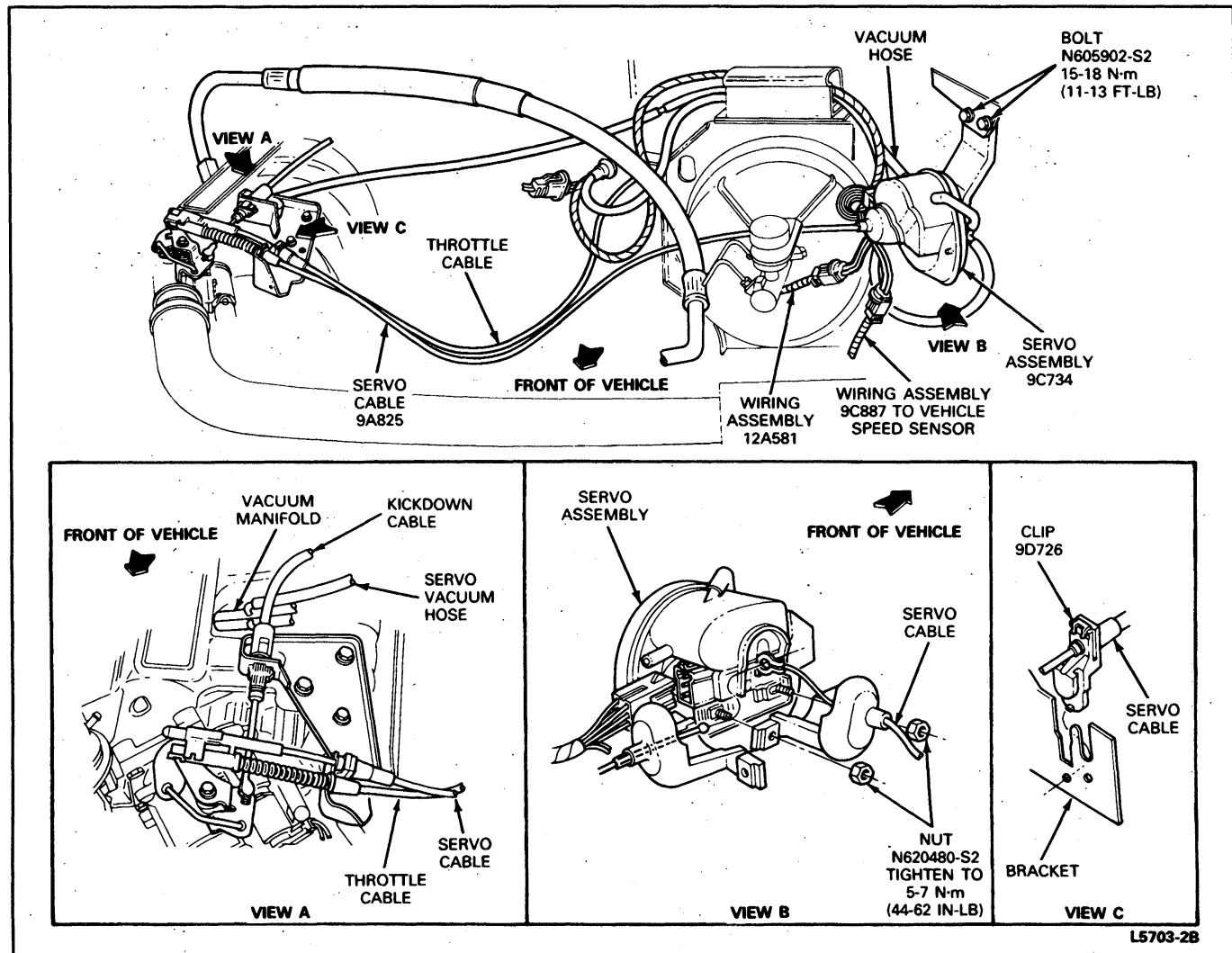


FIG. 16 Servo and Bracket Installation F-150—F-350 and Bronco 5.0L and 5.8L Engines

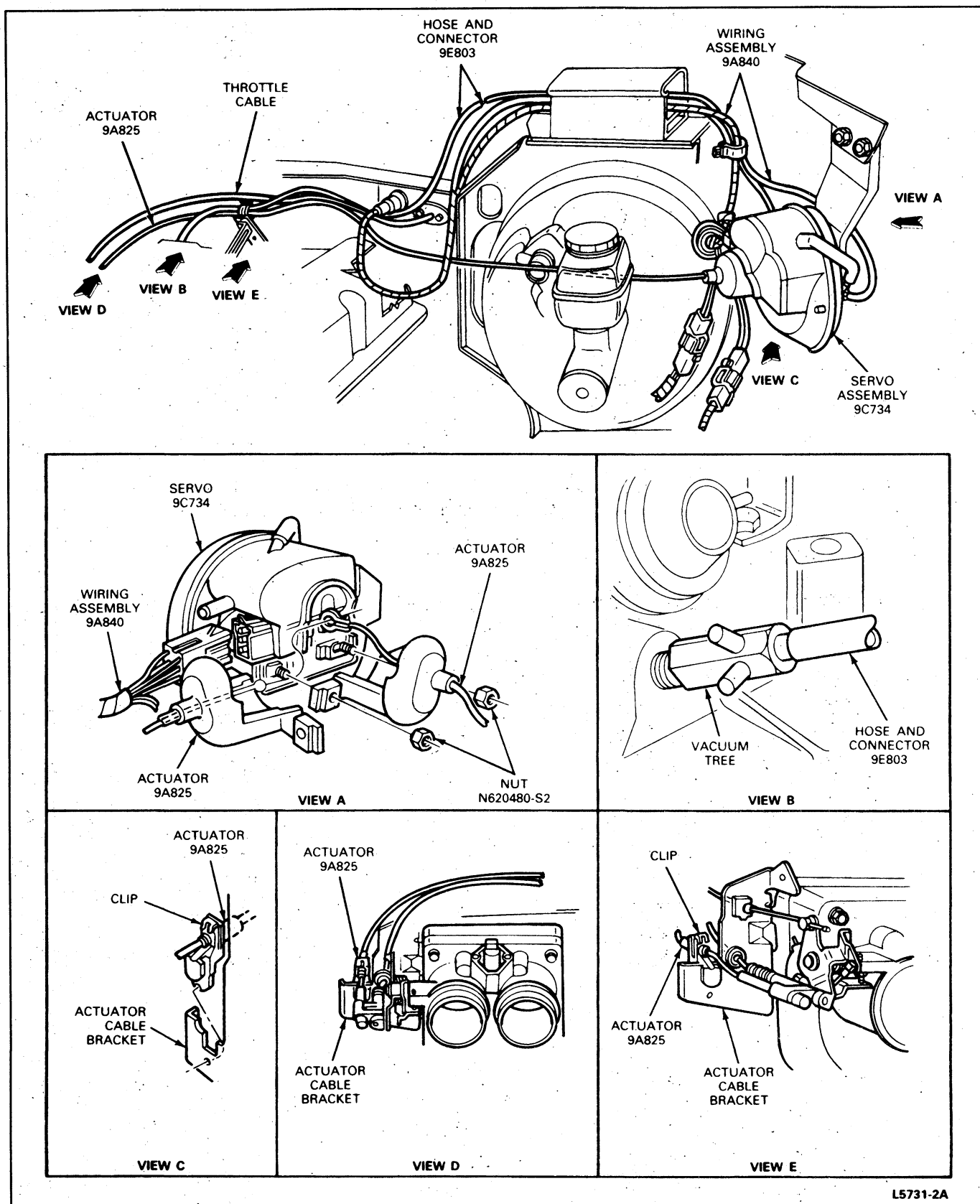


FIG. 17 Servo and Bracket Installation—F-250—F-350 7.5L EFI V-8 Gasoline Engines

zero, perform the control switch test. If the switches check OK, hang in a known good amplifier and check the OFF circuit as above.

### Set-Accelerate Circuit Test

With the ignition on and the voltmeter connected between ground and the light blue-black wire (151), depress the ON switch, then hold SET/ACCEL/ACCL button on steering wheel. Voltmeter should indicate approximately 4.5 volts. Rotate the steering wheel back and forth and watch the voltmeter for fluctuations. If the voltage varies more than 0.5 volt, perform the control switch test.

### Coast Circuit Test

With the ignition on and the voltmeter connected between ground and the light blue-black wire (151), depress the ON switch, then hold the COAST/CST button on steering wheel. Voltmeter should indicate approximately 1.5 volts. If all the functions check OK, perform the servo check and sensor test and hang in a known good amplifier.

### Resume Circuit Test

With the ignition on and the voltmeter connected between the light blue-black mark wire in the six-way connector and ground, depress and hold the RESUME/RSM button on the steering wheel. The voltmeter should read approximately 6.5 volts.

If all the circuits check OK, perform the servo assembly test and hang in a known good amplifier.

### Simulated Road Test

**CAUTION:** When performing this simulated road test, the rear wheels of the vehicle must be raised clear of the floor. Block the front wheels securely and use only a suitable lifting device (such as a garage-type hoist) and support the rear axle with one jack stand on each side. Never attempt to use the vehicle bumper jack for tests of this type.

1. Start the engine.
2. Shift the transmission to DRIVE.
3. Turn on the speed control.

**WARNING: IF ANY TIME DURING THE FOLLOWING STEPS THE SYSTEM SHOULD APPEAR TO GO OUT OF CONTROL AND OVERSPEED, BE PREPARED TO TURN THE SYSTEM OFF AT ONCE WITH THE OFF SWITCH OR THE IGNITION SWITCH.**

4. Accelerate in highest gear (manual transmissions) and hold at 56 Km/h (35 mph).
5. Press and release the SET speed button. Hold foot pressure very lightly on accelerator pedal. Normally the speed will continue at 56 Km/h (35 mph) for a short period of time and then gradually start surging because the engine is not loaded.
6. Press the OFF button. The engine should drop back to idle. Stop the rear wheels with the brake.
7. Press ON button, accelerate and hold the speed at 56 Km/h (35 mph).
8. Press and hold the SET/ACCEL/ACCL button. Slowly remove the foot from the accelerator. The engine speed should gradually increase.
9. When the speed reaches 80 Km/h (50 mph), release the SET/ACCEL/ACCL button. The

vehicle should maintain 80 Km/h (50 mph) for a short time before the surging begins.

10. Press the COAST/CST button and hold. The engine should idle. Slow the rear wheels to 56 Km/h (35 mph).
11. Release the COAST/CST button. Speed should set in. Surging should soon start.
12. Press the brake pedal. The system should shut off, the engine should slow to idle and the wheels should stop.
13. Set the speed at 80 Km/h (50 mph). Brake to 56 Km/h (35 mph) and maintain 56 Km/h (35 mph) with the accelerator. Depress and release the RESUME/RSM button. The speed should return to 80 Km/h (50 mph).

When performing these tests keep the vehicle speeds within reasonably low limits. If the system does not perform as normally expected, make note of the malfunction.

### Road Test

1. Start the engine. Perform speed control system road test in high gear with manual transmission or DRIVE with automatic transmission vehicles.
2. Turn on the speed control.

**WARNING: IF ANY TIME DURING THE FOLLOWING STEPS THE SYSTEM SHOULD APPEAR TO GO OUT OF CONTROL AND OVERSPEED, TURN THE SYSTEM OFF AT ONCE WITH THE OFF SWITCH OR THE IGNITION SWITCH.**

3. Accelerate and hold at 56 Km/h (35 mph).
4. Press and release the set-speed button. Hold foot pressure very lightly on accelerator pedal. Normally the speed will continue at 56 Km/h (35 mph).
5. Press the OFF button (Figs. 1 and 2). The engine should decelerate.
6. Press ON button, accelerate and hold the speed at 56 Km/h (35 mph).
7. Press and hold the SET/ACCEL/ACCL button. Slowly remove foot from the accelerator. The engine speed should gradually increase.
8. When the speed reaches 80 Km/h (50 mph), release the set-speed button.
9. Press the COAST/CST button and hold. The engine should decelerate and slow to 56 Km/h (35 mph).
10. Release the COAST/CST button. Speed should set in.
11. Press the brake pedal. The system should shut off causing the engine to idle.
12. Set the speed at 80 Km/h (50 mph). Brake to 56 Km/h (35 mph) and maintain 56 Km/h (35 mph) with the accelerator. Depress and release the RESUME/RSM button. The speed should return to 80 Km/h (50 mph).

When performing these tests, keep the vehicle speeds within reasonably low limits. If the system does not perform as normally expected, make note of the malfunction.

## Supply Circuit

Blow the horn. This test will determine that there is power in the horn circuit to the steering wheel.

## Brake Stoplamp Switch and Circuit Test

To be performed when brake application will not disconnect the speed control. On manual transmission vehicles, verify that clutch switch is correct, as outlined, before performing the following.

1. Check for stoplamp operation with a maximum brake pedal effort of 26.7N (6 lb). If more than 26.7N (6 lb) effort is required, check the brake pedal actuation and stoplamp switch. Also, check for a burned out brake bulb. Repair or replace as required.
2. If stoplamps work properly, check the battery voltage on the white-purple stripe lead 296 at the amplifier connector (Figs. 8 and 9). Depress the brake pedal until the stoplamps are lit. Check voltage on the red-black stripe lead 810 (E-150—E-350) or on the light green wire (511A) (F-150—F-350 and Bronco) at the same connector. The voltage difference between leads 296 and 810 (Econoline) or 511A (F-Series, Bronco), must not exceed 1.5 volts. The high resistance must be found and corrected in the stoplamp circuit.
3. If the stoplamps do not work, the stoplamp switch, supply circuit, fuses or bulbs must be checked.

## Vacuum Dump Valve Test

The vacuum dump valve releases the vacuum in the servo assembly whenever the brake pedal is depressed. It should be checked whenever brake application does not disconnect the speed control. The dump valve should be pushed sufficiently forward in the retainer clip so that no more than 3.2mm (1/8 inch) of the white (black on Econoline) plunger is showing when the brake pedal is in the released position (Fig. 18).

Disconnect the vacuum hose from the dump valve to the servo at the servo. Connect a hand vacuum pump such as Rotunda 021-00037 or equivalent, to the hose, and pump up a vacuum. If a vacuum cannot be obtained, the hose or the dump valve leaks and should be replaced or adjusted. Step on the brake pedal. The vacuum should be released. If it is not, adjust as described below:

1. Move the valve forward in the retaining clip (Fig. 4, View E) with the valve plunger contacting the brake

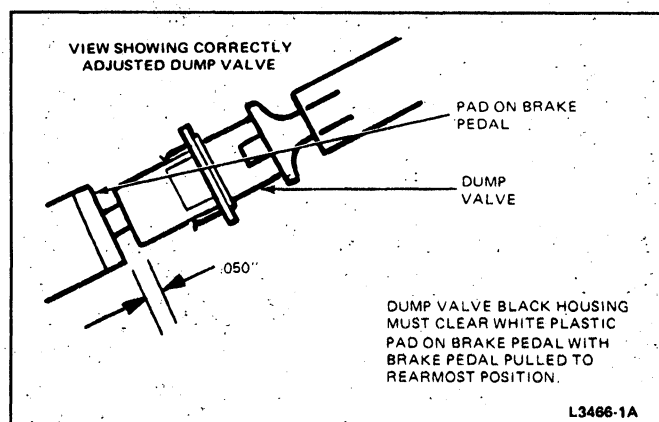


FIG. 18 Dump Valve Adjustment

pedal adapter and the pedal in the released position until 3.2mm (1/8 inch) or less of the plunger shows.

2. Ensure brake pedal is against the stop in the release position after adjustment.

If vacuum still does not release, replace vacuum dump valve.

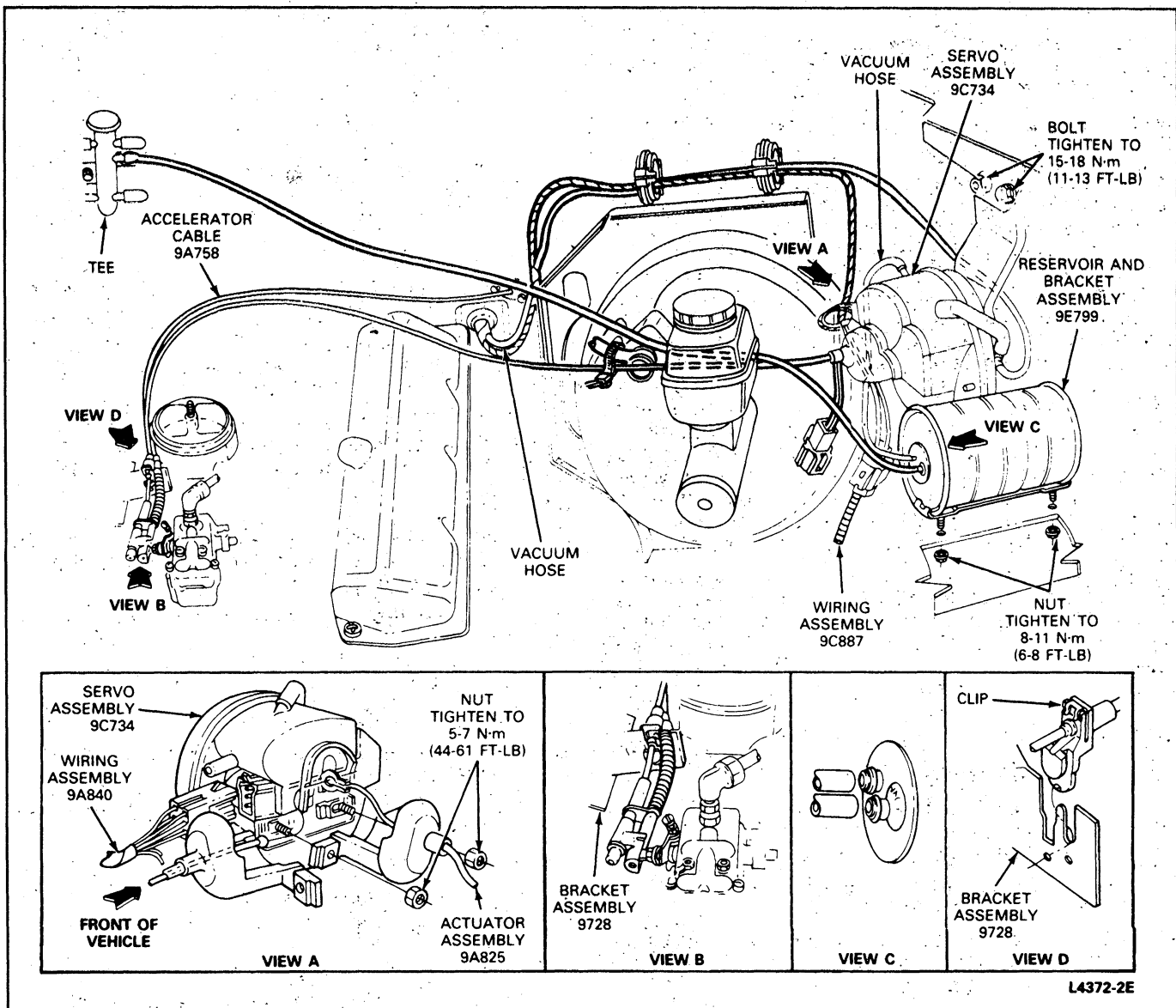
## Vacuum Reservoir Test

To test the vacuum reservoir and check valve for vacuum leakage, proceed as follows:

1. Locate vacuum reservoir on LH apron (Fig. 19). Disconnect vacuum hose at the servo and connect hose to a vacuum gauge with a minimum range of 0-85 kPa (0-25 inches Hg).
2. Start the engine and observe that the vacuum level exceeds 67.4 kPa (20 in. Hg) [77.5 kPa (23 in. Hg) is nominal.] If not, check for leaky vacuum source hose or damaged vacuum pump.
3. Turn off the engine after the vacuum level has stabilized above 67.4 kPa (20 in. Hg). The vacuum level should remain essentially constant and after 24 hours should still exceed 50.5 kPa (15 in. Hg).
4. If the vacuum level can not be maintained, the reservoir should be replaced.

## Horn Relay Circuit Test—E-150—E-350, F-150—F-350 and Bronco

1. Locate horn relay wire connector on the wiring diagram (Figs. 6 and 7).  
NOTE: Connectors remain connected for the following tests.
2. Locate yellow-light blue wire (460) (Figs. 6 and 7).
3. Using voltmeter, measure for battery voltage (approximately 12V) on the pin side of the connector to ground.
4. Locate yellow-light green stripe wire (6) (E-150—E-350) or dark blue (1) (F-150—F-350 and Bronco) (Figs. 6 and 7).
5. Using voltmeter, measure for battery voltage (approximately +12V) on socket side of connector.
6. With voltmeter still connected to socket lead in Step 5, depress horn switch. Voltmeter should read zero. Horn should sound.
7. If voltmeter reading remains at +12V when horn switch is depressed, horn switch or steering column wiring has an open circuit.
8. Before continuing, prove out horn relay by momentarily grounding circuit (1) (F150-F350 and Bronco) or circuit 6 (E150-E350) to body electrical ground or body sheet metal and the horn should sound. This test bypasses horn switch.
9. With circuit from Step 8 grounded, if the horn still does not sound, check for approximately +12V on the dark blue wire (1) (E-150—E-350) or yellow—light green wire (6) (F-150—F-350 and Bronco) when relay operates.
10. If voltage is present at circuit from Step 9 when the relay is operated, an open circuit is present between the horn relay connector and the horn.
11. If the relay does not operate with +12V on circuit (460) and circuit from Step 8 grounded, replace the relay.



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FIG. 19 Servo and Bracket Installation—F-350 w/7.3L Diesel Engine

NOTE: The horn and/or speed control may operate intermittently if the ground brush is missing (Figs. 2 and 3).

### Clutch Switch Test—F-150—F-350, E-150—E-350 and Bronco

#### (Manual Transmission Vehicles Only)

The speed control system is designed to disengage when the clutch pedal is depressed. This is accomplished through a clutch disable switch.

The disengage function operates by opening the 511 circuit (F150-F350 and Bronco) or the 810 circuit (E150-E350) between the speed control module and the stoplamps. This prevents engine overspeed when the clutch is depressed and the speed control is engaged.

The switch is a plastic plunger type mounted to the brake and clutch pedal support on the side near the driver's door. It is actuated by the clutch pedal arm.

NOTE: The switch functions magnetically through a reed switch. Do not use magnetized tools near this switch.

If the switch is open when the clutch pedal is released, the speed control will not operate. This must be corrected before making other tests.

**CAUTION:** Do not use a test lamp to perform the following tests because a lamp cannot properly indicate condition of switch. Use only a voltmeter of 5,000 ohm/volt rating or higher.

To check the switch, disconnect the switch pigtail connector from the speed control harness connector and connect an ohmmeter to the two-switch connector terminals. With the clutch pedal in the full up (released) position the resistance should be less than 5 ohms. With the clutch pedal depressed (switch plunger extended) the circuit should be open.

#### Automatic Transmission

Vehicles equipped with automatic transmissions use a shorting plug instead of a clutch switch.

## Diagnosis Guides

The speed control system diagnosis guides in this Section can be used to determine and isolate speed control problems.

### Speed Decreases—On Steep Grades Or Under Heavy Loads

Verify that a complaint regarding a decrease in speed during high inclines or under heavy-load conditions is not caused by a powertrain limitation. To verify, conduct a road test. Set the speed at about 88.5 Km/h (55 mph) and proceed up a steep grade. When the speed decreases 6.4 to 9.7 Km/h (4 to 6 mph), manually accelerate the vehicle. Verify that the vehicle can maintain the SET speed **without** causing transmission kickdown (a transmission down-shift is acceptable with the overdrive transmissions). If SET speed **can** be maintained manually, a problem exists with the speed control system (e.g., bead chain needs adjustment, vacuum leak or vacuum source not connected to the 7.9mm (5/16 inch) port, a damaged servo or amplifier, etc.). If SET speed **cannot** be maintained without a transmission kickdown, the speed control system is normal and the powertrain capacity is the limiting factor.

NOTE: When the vehicle speed decreases about 16.1 Km/h (10 mph) below the SET speed, the speed control system will, by design, cancel control (similar to the cancellation that occurs when the stoplamps are activated). The servo requires a 8.5 kPa (2.5 inch Hg) minimum vacuum source for normal operation.

## ADJUSTMENTS

### Linkage Adjustment—Actuator Cable

1. Snap the molded speed control actuator cable retainer over the accelerator cable end fitting attached to the throttle ball stud.
2. Remove the adjuster retainer clip, if installed, from the adjuster mounting tab.
3. Insert the speed control actuator cable adjuster mounting tab in the slot provided in the accelerator cable support bracket.
4. Pull cable through adjuster until a slight tension is felt **without** opening the throttle plate or increasing idle rpm.

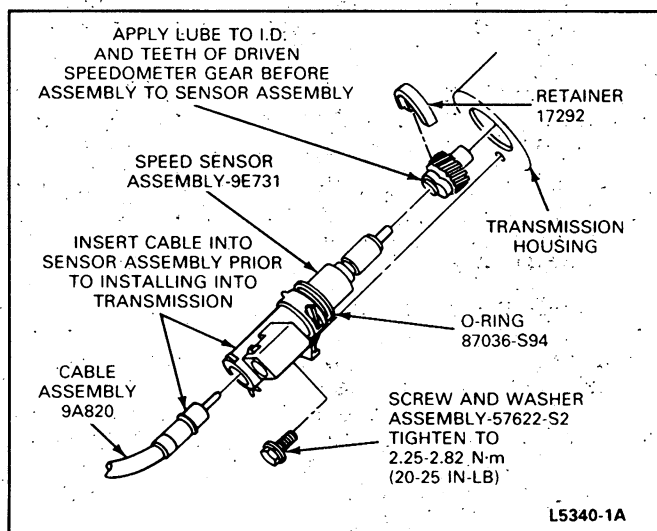


FIG. 20 Speed Sensor Installation—E-150—E-350

5. Insert adjuster retainer clip slowly until engagement is felt and then push downward until it locks in position.

### Vacuum Dump Valve Adjustment

Refer to Vacuum Dump Valve Test.

## REMOVAL AND INSTALLATION

### Control Switches

#### Removal

1. Remove the two retaining screws holding the horn pad assembly to the steering wheel (Fig. 2).
2. Lift up the pad assembly to expose the horn and speed control wire terminals. Disconnect and remove the horn pad assembly.

NOTE: On F-B Series, care must be taken when removing wire terminal in steering wheel. Compress clip firmly. Do not pull on wire or twist.

#### Installation

Attach the wires to the steering wheel hub and the horn pad assembly to the steering wheel with the two retaining screws (Fig. 2).

NOTE: Do not replace individual switch of horn pad assembly.

### Speed Sensor

#### Removal

1. Separate the electrical connector to speed sensor on the transmission.
2. Disconnect speedometer cable from speed sensor (Fig. 20).
3. Remove retaining bolt.
4. Remove the speed sensor.
5. Remove drive gear.

#### Installation

1. Install drive gear on speed sensor. Refer to Section 33-02, Speedometer.
2. Install speed sensor in transmission.
3. Connect speedometer cable.
4. Connect the electrical connector.

### Amplifier Assembly

#### Removal

1. Disconnect the connectors at the amplifier (Fig. 4).
2. Remove the attaching screws or nuts that fasten the amplifier bracket to the vehicle.
3. Remove the amplifier assembly and mounting bracket from the vehicle.
4. Remove the amplifier assembly from the mounting bracket.

#### Installation

1. Install the amplifier on the mounting bracket.
2. Connect the connectors to the amplifier (Fig. 4).
3. Attach the amplifier assembly and mounting bracket to the vehicle with the attaching screws or nuts.

## SPEED CONTROL DOES NOT WORK

TEST STEP		RESULT	ACTION TO TAKE
A0	VERIFY THE CONDITION		GO to A1.
A1	CHECK CONNECTIONS		
	<ul style="list-style-type: none"> <li>Check all electrical and vacuum connections.</li> </ul>	(OK) ► (X) ►	GO to A2. SERVICE or REPLACE as required.
A2	CHECK BRAKE LAMP		
	<ul style="list-style-type: none"> <li>Press brake pedal.</li> <li>Check to see that brake lamp is operating.</li> </ul>	(OK) ► (X) ►	GO to A3 if manual transmission. If automatic transmission GO to A4. SERVICE brake lamp circuit.
A3	CHECK CLUTCH SWITCH (MANUAL TRANSMISSION)		
	<ul style="list-style-type: none"> <li>Check clutch switch for proper operation.</li> </ul>	(OK) ► (X) ►	GO to A4. SERVICE as required.
A4	CHECK THROTTLE ACTUATOR		
	<ul style="list-style-type: none"> <li>Check throttle actuator bead chain (or cable).</li> </ul>	(OK) ► (X) ►	GO to A5. SERVICE as required.
A5	CHECK LINKAGE OPERATION		
	<ul style="list-style-type: none"> <li>Check the throttle linkage for proper operation.</li> </ul>	(OK) ► (X) ►	GO to A6. SERVICE as required.
A6	CHECK VACUUM		
	<ul style="list-style-type: none"> <li>Check vacuum at servo.</li> </ul> NOTE: 2.5 inches of Hg (1.22 psi) is minimum vacuum for normal servo operation. The vacuum source hose is attached to the 7.9mm (5/16 inch), vacuum fitting port or the vacuum reservoir "VAC" port with the 7.3L diesel engine. The servo vacuum source hose is connected to the unmarked vacuum reservoir port.	(OK) ► (X) ►	GO to A8. GO to A7.
A7	CHECK DUMP VALVE		
	<ul style="list-style-type: none"> <li>Check vacuum dump valve.</li> </ul>	(OK) ► (X) ►	SERVICE or REPLACE vacuum hose as required. SERVICE or ADJUST as required.

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**SPEED CONTROL DOES NOT WORK (Continued)**

TEST STEP		RESULT	ACTION TO TAKE
<b>A8</b>	<b>PERFORM CONTROL SWITCHES AND CIRCUIT TESTS</b>		
	<ul style="list-style-type: none"> <li>Perform control switches and circuit tests as described in this Section.</li> </ul>	(OK) ► (X) ►	GO to <b>A9</b> .  SERVICE circuit or REPLACE horn pad assembly as required.
<b>A9</b>	<b>PERFORM SERVO TESTS</b>		
	<ul style="list-style-type: none"> <li>Perform servo tests as described in this Section.</li> </ul>	(OK) ► (X) ►	GO to <b>A10</b> .  REPLACE actuator.
<b>A10</b>	<b>PERFORM SENSOR TEST</b>		
	<ul style="list-style-type: none"> <li>Perform sensor test as described in this Section.</li> </ul>	(OK) ► (X) ►	GO to <b>A11</b> .  REPLACE sensor.
<b>A11</b>	<b>PERFORM AMPLIFIER TEST</b>		
	<ul style="list-style-type: none"> <li>Perform amplifier test as described in this Section (Substitution)</li> </ul>	Problem corrected ►  Problem not corrected ►	INSTALL a new amplifier.  EXAMINE all connectors carefully for proper contact. REPAIR as required. REMOVE substitute amplifier.

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4. Road test and check the system for proper operation.

**Servo Assembly (Throttle Actuator)****Removal**

1. Disconnect the wiring harness connectors under the hood at the servo assembly (Figs. 10 through 17).
2. Disconnect the adjuster from accelerator cable and disconnect the vacuum hose at the servo Y.
3. Remove the screw attaching the actuator cable to the retaining bracket.
4. Remove the pins and nuts retaining the servo assembly to the mounting bracket and remove the servo assembly.

**Installation**

1. Position the servo assembly to the bracket and install the retaining nuts. Connect the vacuum hose.
2. Attach the actuating cable to the retaining bracket.
3. Connect the adjuster to the accelerator cable.
4. Connect the wiring harness connectors under the hood at the servo assembly.

**Actuator Cable**

For removal and installation refer to Servo Assembly. Remove the actuator cable from the servo assembly (Figs. 10 through 17). Reverse the procedure for installation.

**Vacuum Dump Valve****Removal**

1. Remove the vacuum hose from the valve and remove the bracket mounting screw (Fig. 4, View E). On F-Series or Bronco vehicles the dump valve can be replaced without removing the bracket.
2. Remove the valve and bracket assembly.
3. Remove the valve from the bracket.

**Installation**

1. Install the valve to the bracket.
2. Install the bracket mounting screw.
3. Connect the vacuum hose.
4. Adjust dump valve.

**Vacuum Reservoir—7.3L Diesel Engine**

Refer to Fig. 19.

## SPEED CONTROL OPERATION IS INTERMITTENT

TEST STEP		RESULT	ACTION TO TAKE
<b>B0</b>	<b>VERIFY THE CONDITION</b>		
	<ul style="list-style-type: none"> <li>Note carefully when intermittent action occurs.</li> </ul>		GO to B1.
<b>B1</b>	<b>INSPECT VISUALLY</b>		
	<ul style="list-style-type: none"> <li>Perform visual inspection test.</li> </ul>	If intermittent action occurs while cruising If intermittent action occurs while using control buttons or turning steering wheel	GO to B2. GO to B4.
<b>B2</b>	<b>CHECK VACUUM TO SERVO</b>		
	<ul style="list-style-type: none"> <li>Check vacuum supply to servo.</li> </ul> <p>NOTE: 2.5 inches of Hg (1.22 psi) is minimum vacuum for normal servo operation. The vacuum source hose is attached to the 7.9 mm (5/16 inch) engine vacuum-fitting port or the vacuum reservoir "VAC" port with the 6.9L diesel engine.</p>	(OK) (X)	GO to B3. SERVICE vacuum supply.
<b>B3</b>	<b>PERFORM SERVO ASSEMBLY TEST</b>		
	<ul style="list-style-type: none"> <li>Perform servo assembly test. Lightly tap servo body while making test.</li> </ul>	(OK) (X)	SUBSTITUTE known good amplifier if OK — properly INSTALL amplifier. REPLACE servo assembly.
<b>B4</b>	<b>PERFORM CONTROL SWITCHES AND CIRCUIT TESTS</b>		
	<ul style="list-style-type: none"> <li>Perform control switches and circuit tests as described in this Section.</li> </ul>	(OK) (X)	SUBSTITUTE known good amplifier if OK — properly INSTALL amplifier. REPAIR circuits, REPLACE horn pad assembly. CLEAN or SERVICE three copper brushes and steering wheel ring.

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**Removal**

1. Disconnect both vacuum hoses from the two ports located on the reservoir.
2. Remove the two nuts retaining the reservoir from the underside of the LH apron and remove the reservoir.

**Installation**

1. Position the reservoir to the LH apron. Secure with two nuts and tighten.
2. Connect the two vacuum hoses to the reservoir.

NOTE: Be certain when connecting the vacuum hoses that hoses are connected to the proper vacuum outlet at the reservoir.

**Ground Brush****Removal**

1. Remove the steering wheel for access. Refer to Section 13-06, Steering Column-Shift Rod Within Tube.
2. Snap the brush assembly out of the turn signal switch.

**Installation**













1. Install the ground brush in the turn signal switch. (If the turn signal switch was lifted off the column when removing the ground brush, install the turn signal switch.)
2. Install the steering wheel horn pad assembly and the steering wheel (Fig. 2). Refer to Section 13-06,

Steering Column-Shift Rod Within Tube for steering wheel installation.

**Clutch Deactivator Switch (Manual Transmission Only)**

1. Remove nut and bolt attaching switch to bracket.
2. Disconnect switch connector.
3. Reverse Steps 1 and 2 for installation.

**SPEED CONTROL OPERATES BUT DOES NOT ACCELERATE OR COAST DOWN PROPERLY**

TEST STEP		RESULT	ACTION TO TAKE
<b>C0</b>	<b>PERFORM VISUAL INSPECTION TEST</b>		
	<ul style="list-style-type: none"> <li>• Visually inspect system.</li> </ul>	<p>  GO to <b>C1</b>.</p> <p>  SERVICE or REPLACE affected circuit.</p>	
<b>C1</b>	<b>PERFORM CONTROL SWITCHES AND CIRCUIT TESTS</b>		
	<ul style="list-style-type: none"> <li>• Perform control switches and circuit tests as described in this Section.</li> </ul>	<p>  GO to <b>C2</b>.</p> <p>  SERVICE circuits or REPLACE horn pad assembly.</p>	
<b>C2</b>	<b>PERFORM SERVO ASSEMBLY TEST</b>		
	<ul style="list-style-type: none"> <li>• Perform servo assembly test as described in this Section.</li> </ul>	<p>  SUBSTITUTE known good amplifier if OK, REPLACE amplifier.</p> <p>  REPLACE servo assembly.</p>	

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## SPEED CONTINUOUSLY CHANGES UP AND DOWN

TEST STEP		RESULT	ACTION TO TAKE
D0	VERIFY CONDITION		GO to D1.
D1	CHECK THROTTLE ACTUATOR		
	<ul style="list-style-type: none"> <li>Check throttle actuator for proper operation and adjustment.</li> </ul>	(OK) → (X) →	GO to D2. SERVICE or ADJUST as required.
D2	CONTINUITY CHECK		
	<ul style="list-style-type: none"> <li>Check continuity of circuits 147, 148 and 149 on F-150 — F-350 and Bronco. Check continuity of circuits 735, 827 and 828 on E-150 — E-350.</li> </ul>	(OK) → (X) →	GO to D3. REPAIR or REPLACE wiring as necessary.
D3	TEST SERVO		
	<ul style="list-style-type: none"> <li>Perform servo test as described in this Section.</li> </ul>	(OK) → (X) →	GO to D4. REPLACE as required.
D4	CHECK SPEEDOMETER CABLES		
	<ul style="list-style-type: none"> <li>Check speedometer cables for proper routing, no sharp bends or binding.</li> </ul>	(OK) → (X) →	GO to D5. SERVICE as required.
D5	CHECK SENSOR		
	<ul style="list-style-type: none"> <li>Check sensor for free operation. At 30 mph, the output voltage is constant in the range 2.5-4.9 V.R.MS with a 4K ohms resistance load coil resistance is 200 ohms.</li> </ul>	(OK) → (X) →	GO to D6. REPLACE sensor.
D6	TEST SENSOR		
	<ul style="list-style-type: none"> <li>Perform sensor test as described in this Section.</li> </ul>	(OK) → (X) →	GO to D7. REPLACE speed sensor.
D7	CHECK DUMP VALVE		
	<ul style="list-style-type: none"> <li>Check vacuum dump valve.</li> </ul>	(OK) → (X) →	GO to D8. SERVICE or ADJUST as required.
D8	TEST AMPLIFIER		
	<ul style="list-style-type: none"> <li>Perform amplifier test as described in this Section.</li> </ul>	Corrects problem → Does not correct problem →	REPLACE amplifier. CHECK circuit connections for good contacts. SERVICE as required.

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**SPEED CONTROL DOES NOT DISENGAGE  
WHEN BRAKES ARE APPLIED**

TEST STEP		RESULT	ACTION TO TAKE
<b>E0</b>	VERIFY THE CONDITION		GO to <b>E1</b> .
<b>E1</b>	CHECK STOPLAMPS		
	<ul style="list-style-type: none"> <li>• Apply brakes and observe stop lamps.</li> </ul>	<div> <div>OK</div> <div> <div>OK</div> <div> </div> </div> </div>	GO to <b>E2</b> .
		<div> <div>OK</div> <div> <div>OK</div> <div> </div> </div> </div>	SERVICE stoplamp circuit as required. VERIFY fuses are not open. GO to <b>E2</b> .
<b>E2</b>	CHECK DUMP VALVE		
	<ul style="list-style-type: none"> <li>• Check vacuum dump valve.</li> </ul>	<div> <div>OK</div> <div> <div>OK</div> <div> </div> </div> </div>	GO to <b>E3</b> .
		<div> <div>OK</div> <div> <div>OK</div> <div> </div> </div> </div>	ADJUST or SERVICE as required.
<b>E3</b>	CHECK SERVO		
	<ul style="list-style-type: none"> <li>• Check servo operation and throttle linkage.</li> </ul>	<div> <div>OK</div> <div> <div>OK</div> <div> </div> </div> </div>	GO to <b>E4</b> .
		<div> <div>OK</div> <div> <div>OK</div> <div> </div> </div> </div>	REPLACE servo.
<b>E4</b>	TEST AMPLIFIER		
	<ul style="list-style-type: none"> <li>• Perform amplifier test as described in this Section.</li> </ul>	<div> <div>Corrects problem</div> <div> <div>Does not correct problem</div> <div> </div> </div> </div>	<div> <div>REPLACE amplifier.</div> <div> <div>CHECK contacts of green connector.</div> <div>SERVICE as required.</div> </div> </div>



CL4366-2B

## SPEED WILL NOT SET IN SYSTEM

TEST STEP		RESULT	ACTION TO TAKE
<b>F0</b>	VERIFY THE CONDITION		GO to F1.
<b>F1</b>	CHECK THROTTLE ACTUATOR		
	<ul style="list-style-type: none"> <li>Check throttle actuator for proper operation and adjustment.</li> </ul>	(OK) → GO to F2. (X) → ADJUST or SERVICE as required.	
<b>F2</b>	CHECK CONNECTIONS		
	<ul style="list-style-type: none"> <li>Check system circuit connections.</li> </ul>	(OK) → GO to F3. (X) → SERVICE as required.	
<b>F3</b>	CHECK CONTROL SWITCH		
	<ul style="list-style-type: none"> <li>Check control switch circuit.</li> </ul>	(OK) → GO to F4. (X) → SERVICE switch circuit as required.	
<b>F4</b>	CHECK DUMP VALVE		
	<ul style="list-style-type: none"> <li>Check vacuum dump valve.</li> </ul>	(OK) → GO to F5 for manual transmission, F6 for automatic transmission. (X) → ADJUST or SERVICE as required.	
<b>F5</b>	CHECK CLUTCH SWITCH		
	<ul style="list-style-type: none"> <li>Check clutch switch.</li> </ul>	(OK) → GO to F6. (X) → SERVICE switch as required.	
<b>F6</b>	CHECK STOPLAMPS		
	<ul style="list-style-type: none"> <li>Check stoplamps, switch and circuit.</li> </ul>	(OK) → GO to F7. (X) → SERVICE lamps and circuit as required.	
<b>F7</b>	CHECK SERVO		
	<ul style="list-style-type: none"> <li>Check servo for proper operation.</li> </ul>	(OK) → GO to F8. (X) → REPLACE servo.	
<b>F8</b>	CHECK SENSOR		
	<ul style="list-style-type: none"> <li>Check speed control sensor.</li> </ul>	(OK) → CHECK amplifier, REPLACE as required. (X) → REPLACE sensor.	







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**SPEED CONTROL SYSTEM DOES NOT DISENGAGE WHEN CLUTCH PEDAL IS DEPRESSED  
(MANUAL TRANSMISSION ONLY)**

TEST STEP		RESULT	ACTION TO TAKE
<b>G0</b>	<b>VERIFY</b>		
<ul style="list-style-type: none"> <li>• Verify system disengages when stoplamp switch is activated.</li> <li>• Check clutch switch operation.</li> </ul>		<p align="center">   </p>	<p>SERVICE or REPLACE wire assembly 9A840 as required.</p> <p>SERVICE or REPLACE as required.</p>

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**SPEED GRADUALLY INCREASES OR DECREASES AFTER SPEED IS SET**

TEST STEP		RESULT	ACTION TO TAKE
<b>H0</b>	<b>VERIFY*</b>		
<ul style="list-style-type: none"> <li>• Verify that engine is properly tuned.</li> <li>• Check accelerator action and head chain adjustment.</li> </ul>		<p align="center">   </p>	<p>GO to H1.</p> <p>ADJUST or CORRECT as required.</p>
<b>H1</b>	<b>CHECK DUMP VALVE</b>		
<ul style="list-style-type: none"> <li>• Check vacuum dump valve.</li> </ul>		<p align="center">   </p>	<p>GO to H2.</p> <p>ADJUST or SERVICE as required.</p>
<b>H2</b>	<b>TEST SERVO</b>		
<ul style="list-style-type: none"> <li>• Perform servo test.</li> </ul>		<p align="center">   </p>	<p>PERFORM amplifier test. REPLACE if required.</p> <p>REPLACE servo.</p>

\*Perform "Speed Decreases — On Steep Grades or Under Heavy Loads" test in this Section.

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**SPEED CONTROL OPERATES BUT DOES NOT  
RESUME ACCELERATE OR COAST DOWN PROPERLY**

TEST STEP		RESULT	ACTION TO TAKE
J0	VERIFY THE CONDITION		GO to J1.
J1	CHECK FOLLOWING SWITCHES AND CIRCUITS		
	<ul style="list-style-type: none"> <li>Check the SET-ACCEL switch, Coast switch, RESUME switch and slip ring circuits and brush contacts.</li> </ul>	(OK) ► (X) ►	GO to J2. SERVICE the circuit as required.
J2	TEST SERVO		
	<ul style="list-style-type: none"> <li>Perform servo test.</li> </ul>	(OK) ► (X) ►	GO to J3. REPLACE servo.
J3	TEST AMPLIFIER		
	<ul style="list-style-type: none"> <li>Perform amplifier test as described in this Section.</li> </ul>	Corrects problem. ► Does not correct problem. ►	REPLACE amplifier. CHECK circuit connections for proper contact. SERVICE as required.

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## SPECIFICATIONS

### ROTUNDA EQUIPMENT

Model	Description
007-00013	Speed Control Tester
007-00001	Digital Volt-Ohmmeter
021-00037	Vacuum Pump

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# GROUP SEATS 41

(70000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
CONVENTIONAL REAR SEATS .....	41-14-1	SEAT AND SHOULDER BELTS .....	41-50-1
FOLDING REAR SEATS .....	41-20-1	SEAT BACK LATCH .....	41-25-1
FRONT SEATS .....	41-01-1	SEAT TRIM .....	41-60-1

## SECTION 41-01 Front Seats

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Captain's Chair .....	41-01-1	Captain's Chairs .....	41-01-7
Latch Band .....	41-01-1	Front Seat Back Adjuster (Recliner)	
Captain's Chair .....	41-01-1	Actuator Cable .....	41-01-9
<b>DESCRIPTION</b> .....	41-01-1	Seat Support .....	41-01-11
<b>REMOVAL AND INSTALLATION</b>		Seat Tracks .....	41-01-7
Bench Seat .....	41-01-2	<b>SPECIFICATIONS</b> .....	41-01-13
Bucket Seats .....	41-01-2	<b>VEHICLE APPLICATION</b> .....	41-01-1

### VEHICLE APPLICATION

All E-150—E-350, F-150—F-350 Crew Cab, F-Super Duty, and Bronco Vehicle Models.

### DESCRIPTION

The captain's chair on E-Series and Club Wagon mounts on a swivel pedestal attached to the vehicle floor. The bench seat on F-Series and Bronco mounts on two seat tracks attached to the vehicle floor.

The bucket seats on E-Series, F-Series and Bronco mount on two seat tracks. The seat tracks mount on a fixed pedestal (E-150—E-350) or to the vehicle floor (F-150—F-350 and Bronco).

The captain chair's on F-Series Super Cab and Bronco mounts to a seat track assembly attached to the vehicle floor.

### ADJUSTMENTS

#### Captain's Chair

The captain's chair on Econolines can be adjusted for either forward facing or rearward facing. However, the chair is intended to be locked in the forward facing direction when the vehicle is in motion.

To rotate the seat, actuate the handle rearward to unlatch the seat and rotate (Fig. 1). The seat automatically latches in either the forward or rearward facing positions. The seat may be more firmly locked in the latch position against slight movements by sliding the lock handle forward.

The bench and bucket seat adjustment lever is located at the LH front of the seat cushion. Pulling the lever to the left releases the lock mechanism, permitting fore and aft seat adjustment. Releasing the lever will lock the seat in the new position.

#### Latch Band

##### Captain's Chair

Captain's chairs exhibiting side-to-side movement while latched in the forward facing position may be serviced by adjusting latch band as follows:

1. Rotate the swivel pedestal (Lear Siegler design) as follows:
  - Driver's seat - adjust the outboard armrest to the down position.
  - Passenger seat - adjust the outboard armrest to the up position.

- Adjust the seat back to the full upright position.
  - Adjust the seat tracks to the mid position.
  - Slide the swivel pedestal's actuator lever rearward. Rotate the seat and pedestal sufficiently to ensure that the latch pawl will not engage the pedestal tube slot when the actuator lever is released. Then, release the lever (Fig. 2, View A).
2. Tighten the latch band adjusting bolt until all play is removed from support-to-pedestal mount. A good indicator is that the latch pawl will not engage in the slot in the tube when the swivel pedestal is rotated to the forward facing position (Fig. 2, View A).
  3. Rotate the seat and pedestal assembly to the forward facing position, ensuring that the latch pawl aligns with the slot in the tube.
  4. Slowly loosen the latch band adjusting bolt until the latch pawl "snaps" into the slot in the tube (Fig. 2, View B). Check support-to-pedestal mount to ensure that no play is present.
  5. Actuate the swivel pedestal's release lever and rotate the seat and pedestal assembly. Then, release the actuator lever and rotate the seat and pedestal assembly to the forward facing position. The latch pawl should "snap" into the slot. Check the latch pawl for full engagement in the slot. Refer to Fig. 2, View B.

## REMOVAL AND INSTALLATION

**CAUTION:** Use care when handling seat and track assembly. Dropping assembly or sitting on seat when not secured in vehicle could result in damaged components.

### Bench Seat

#### F-150—F-350 and Bronco

Refer to Fig. 3.

#### Removal

1. Remove the seat track-to-floorpan retaining screws (two on each side) and lift the seat and track assembly out of the vehicle.

#### Installation

1. Apply Caulking Cord D6AZ-19560-A or equivalent around seat track assembly attaching bolt locations on floorpan.
2. Position the seat and track assembly in the vehicle and secure it to the floorpan with the retaining screws. Tighten the screws to 25-44 N·m (19-32 ft-lb).
3. Install the seat track bolt plastic cover using the attachment screw.

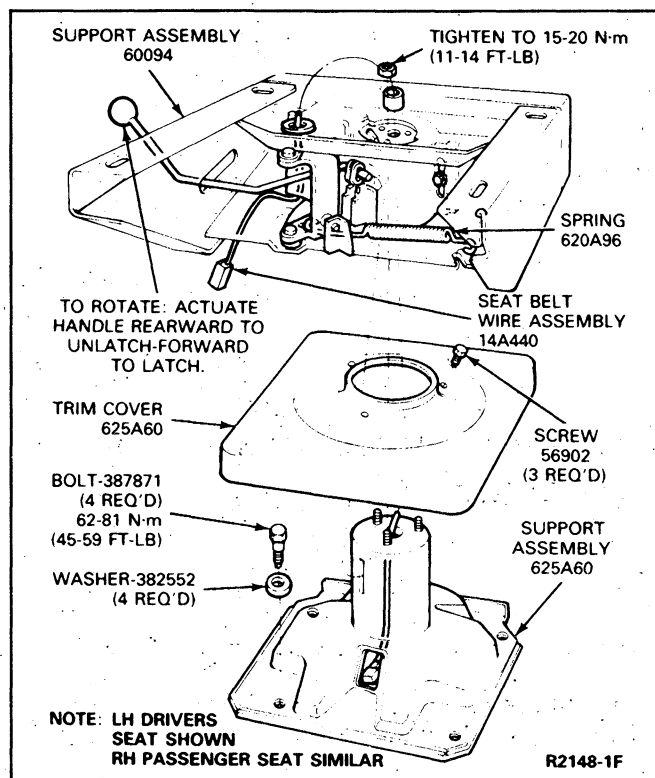
### Bucket Seats

#### E-150—E-350—Driver and Passenger

Refer to Fig. 4.

#### Removal

1. Remove nut and washer assemblies securing seat and track assembly to support assembly (four).
2. Remove seat and track assembly from vehicle.



**FIG. 1 Swivel Pedestal—Captain's Chair—E-150—E-350 and Club Wagon**

3. Remove four support-to-floorpan retaining bolts and washers (two on each side) and lift the support assembly out of the vehicle.

#### Installation

1. Position seat and track assembly on support assembly.
2. Install nut and washer assemblies securing seat and seat track to support assembly. Tighten nuts to 10-23 N·m (8-17 ft-lb).
3. Apply Caulking Cord D6AZ-19560-A or equivalent around support assembly attaching bolt locations on floorpan.
4. Position the support assembly in the vehicle and secure it to the floorpan with the retaining bolts and washers. Tighten the support assembly-to-floorpan screws to 61-81 N·m (45-59 ft-lb).

#### F-150—F-350 Super Cab and Bronco—Driver's Seat

#### Removal

Refer to Fig. 5.

1. Remove support assembly-to-floor bolts and lift the seat and track assembly from vehicle.

#### Installation

1. Apply Caulking Cord D6AZ-19560-A or equivalent under the seat track assembly.
2. Position seat and track assembly on the floor and secure bolts. Apply sealer around support assembly attaching bolt locations on floorpan (Fig. 5). Tighten bolts to 25-44 N·m (19-32 ft-lb).

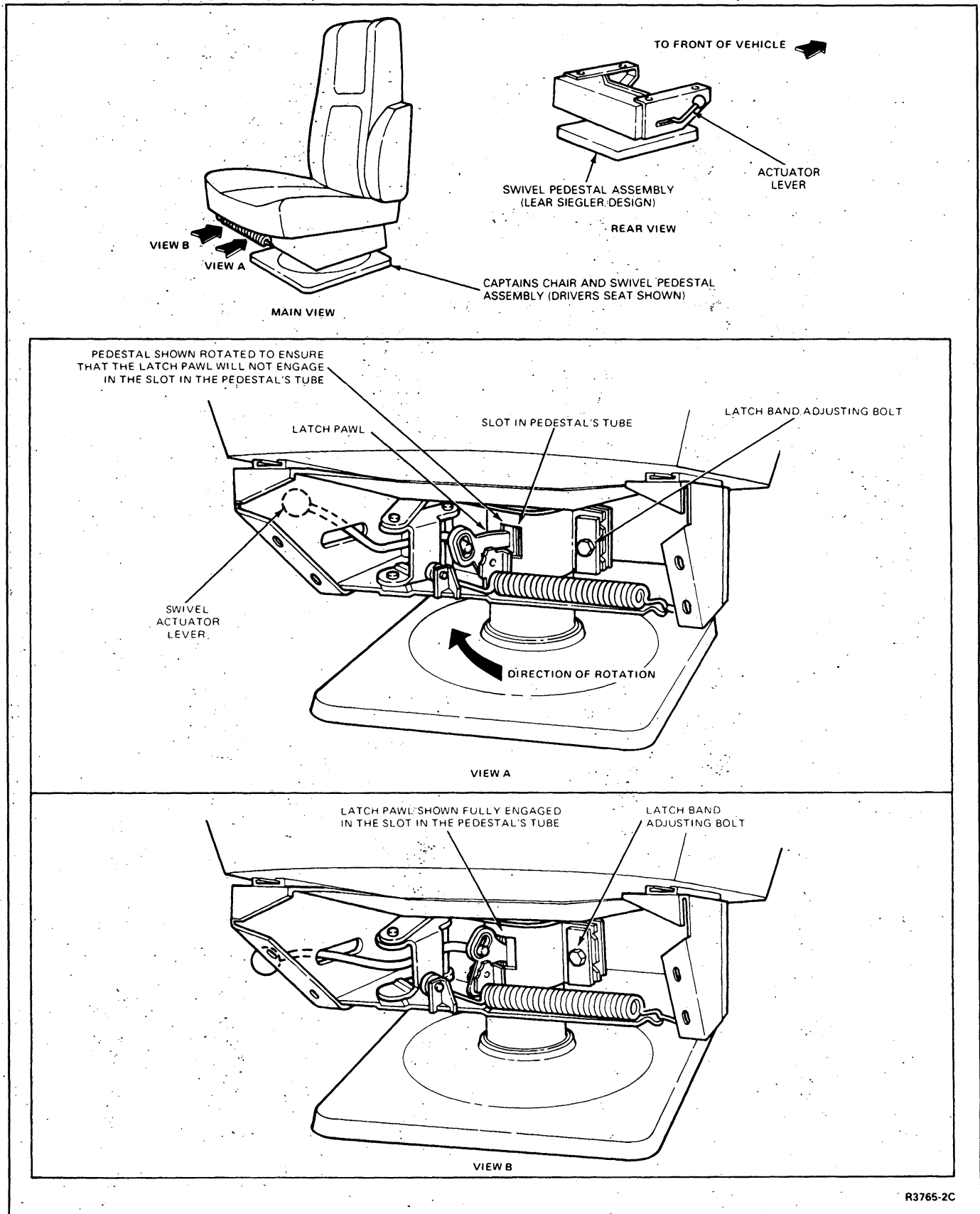


FIG. 2 Swivel Pedestal Assembly Latch Band Adjustment—E-150—E-350 and Club Wagon

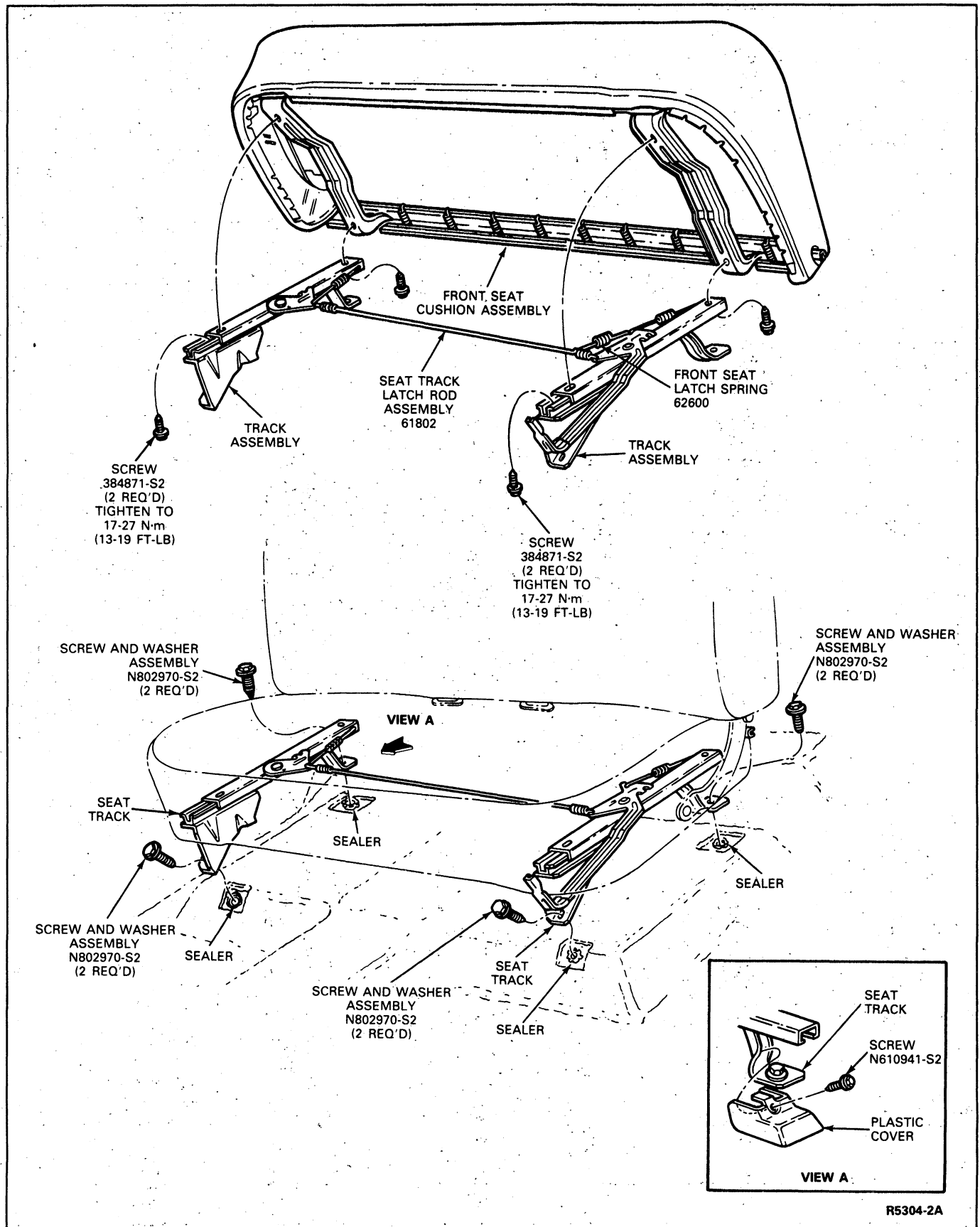


FIG. 3 Bench Seat and Track Installation—F-150—F-350, F-350 Crew Cab, F-Super Duty and Bronco

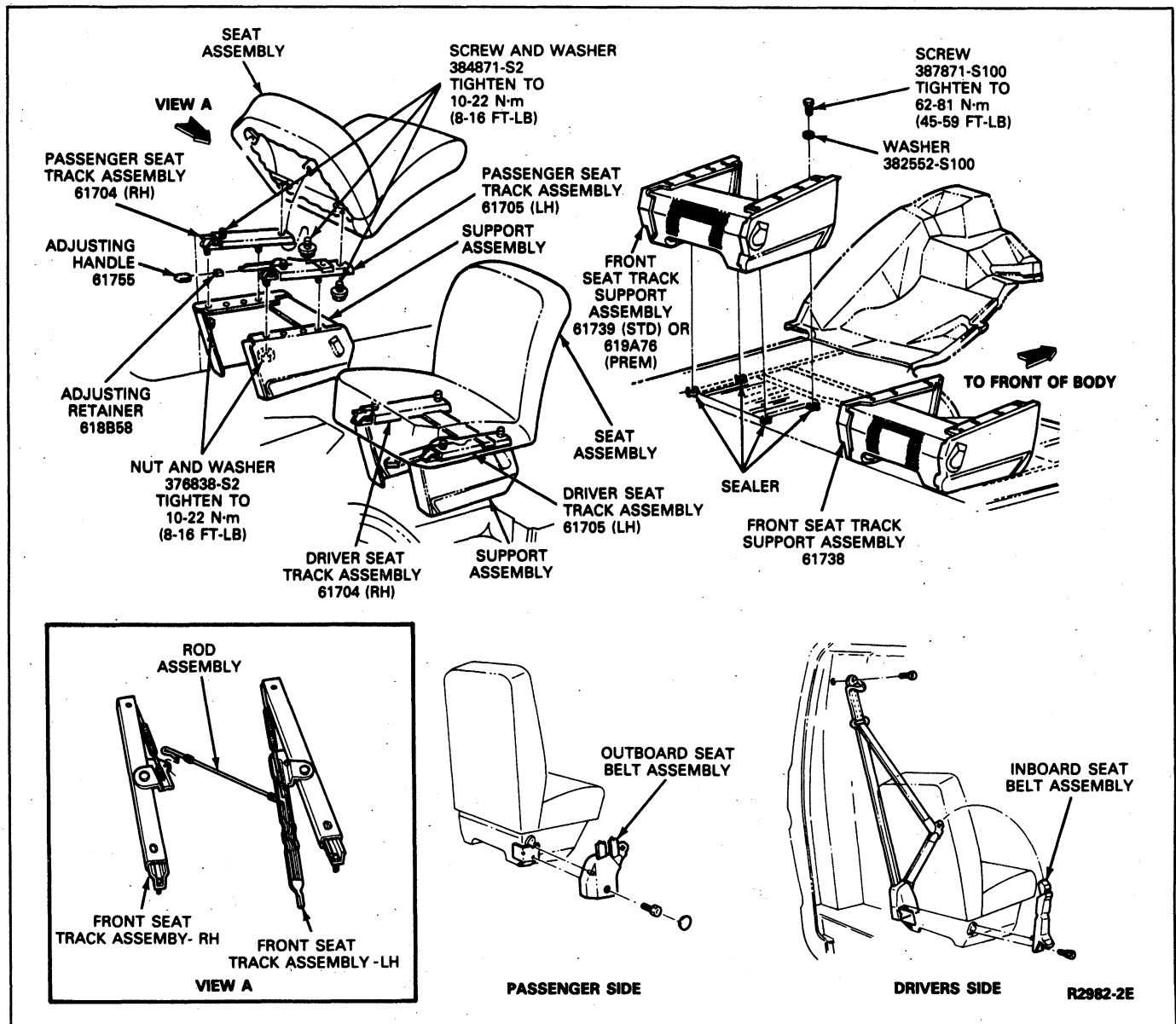


FIG. 4 Bucket Seat and Track Installation—E-150—E-350

### F-150—F-350 Super Cab and Bronco—Passenger Seat—Bucket/Captain's Chair

#### Removal

1. Remove the two front bolts retaining the passenger seat and support assembly to the floorpan (Fig. 5).
2. Move the seat release lever rearward, causing the seat to "pop-up" and fold forward. Then remove the two rear bolts used to retain the seat and support assembly to the floorpan (Fig. 5).
3. Disengage one end of the passenger seat support stop cable.
4. Move the seat and support assembly rearward until the seat back clears the instrument panel when folded forward. Then, fold the seat full forward and disengage the ends of the three assist springs from their retainers.
5. Return the seat back to an upright position, then push the seat back down firmly until the seat is

latched. Remove the seat and support assembly from the vehicle and place it on a clean, flat work surface.

**WARNING: TO ENSURE THE SAFETY OF THE TECHNICIAN, IT IS CRUCIAL THAT THE ENDS OF THE THREE PASSENGER SEAT SUPPORT ASSIST SPRINGS BE DISENGAGED FROM THEIR RETAINERS BEFORE THE SEAT AND SUPPORT ASSEMBLY IS REMOVED FROM THE VEHICLE.**

#### Installation

1. Disengage ends of the passenger seat support assembly assist springs from their retainers. Position the seat and support assembly in the vehicle far enough rearward of the seat support-to-floor attaching holes to enable the seat back to clear the instrument panel when folded forward.

**WARNING: TO ENSURE THE SAFETY OF THE TECHNICIAN, IT IS CRUCIAL THAT THE THREE PASSENGER SEAT SUPPORT ASSIST SPRINGS BE DISENGAGED FROM THEIR RETAINERS BEFORE**

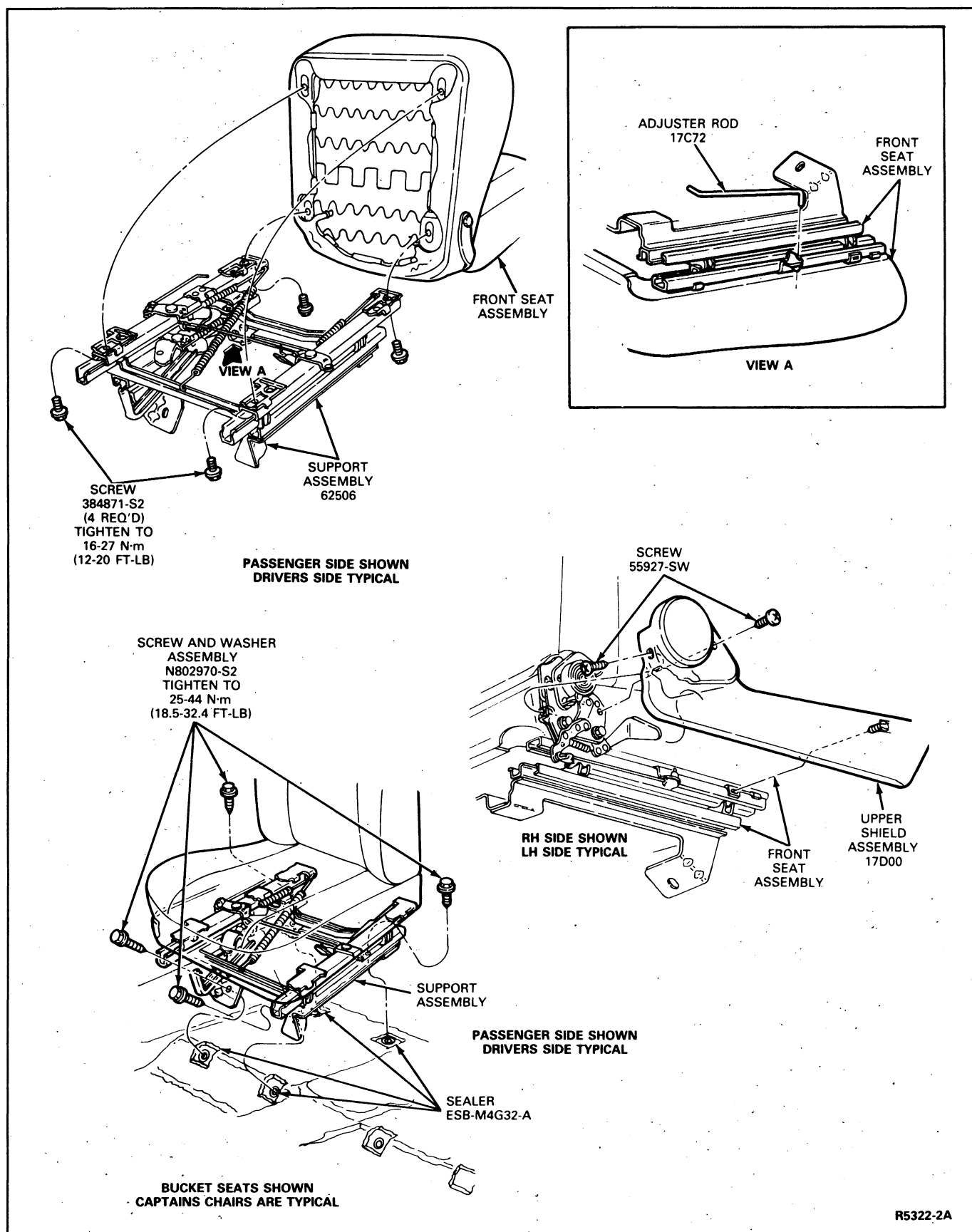


FIG. 5 F-150—F-350 Super Cab and Bronco Bucket Seat Installation

## THE SEAT AND SUPPORT ASSEMBLY IS INSTALLED IN THE VEHICLE.

2. Unlatch the seat support assembly. Then, fold the seat forward.
3. Install the ends of the assist springs into their retainers (Fig. 5).
4. Return the seat to an upright position. Then, push the seat back down firmly until the seat support assembly is latched. Apply Caulking Cord D6AZ-19560-A or equivalent around floorpan attaching holes.
5. Position the seat and support assembly over the floorpan attaching holes. Then, install the two front attaching bolts but DO NOT tighten (Fig. 5).
6. Install the end of the passenger seat support stop cable.
7. Operate the seat support release lever, causing the seat to "pop-up" and fold forward. Then, install the two rear seat support-to-floorpan attaching bolts. Tighten the four attaching bolts to 25-44 N·m (19-32 ft-lb).
8. Move the seat to an upright position, then push the seat back down firmly until the seat support assembly is latched.
9. Check the seat support assembly for proper operation.

**WARNING: TO ENSURE THE SEAT SUPPORT ASSEMBLY IS IN AN UNLATCHED POSITION, A MEASURED DISTANCE OF 102MM (4 INCHES) OR MORE IS REQUIRED BETWEEN THE BUMPER AND THE LOWER SUPPORT.**

NOTE: For captain's chair applications perform the following:

10. Operate the seat support release lever rearward. Ensure the seat back adjuster permits the seat back to fold forward at approximately the same time the seat support assembly unlatches and "pops-up." In the event the seat assembly and/or the seat back does not release properly, it will be necessary to adjust the release cable by moving the slotted cable retainer fore-or-aft as required (Fig. 5).

### Captain's Chairs

#### F-150—F-350 Super Cab and Bronco—Drivers Seat (LH)

Refer to Fig. 5.

#### Removal

1. Remove and retain four seat track-to-floor bolts.
2. Remove the seat and seat track assembly from vehicle.

#### Installation

1. Apply Caulking Cord D6AZ-19560-A or equivalent around attaching screw locations on floorpan.
2. Position the seat and seat track assembly in the vehicle.
3. Install four bolts securing seat tracks-to-floor. Tighten bolts to 25-44 N·m (18.5-32.4 ft-lb).

#### E-150—E-350 and Club Wagon, Driver and Passenger Seats With Fixed Support or Swivel Pedestal

Refer to Fig. 6.

#### Removal

1. Remove the four nut and washer assemblies (two each side) securing seat and seat track to fixed support or swivel pedestal.
2. Remove seat and track assembly from vehicle.
3. On vehicles with fixed support, remove four bolt and washer assemblies retaining support to vehicle floor. Remove fixed support from vehicle.
4. On vehicles with swivel pedestal, remove three screws retaining trim cover to pedestal and remove cover, and remove four bolt and washer assemblies retaining swivel pedestal to vehicle floor. Remove swivel pedestal from vehicle.

#### Installation

1. Apply Caulking Cord D6AZ-19560-A or equivalent around fixed support or swivel pedestal attaching bolt location on floorpan.
2. To install fixed support. Position support on floorpan and install four bolt and washer assemblies. Tighten to 61-81 N·m (45-59 ft-lb).
3. To install swivel pedestal, position pedestal on floorpan, lift up trim cover and install four bolt and washer assemblies. Tighten to 61-81 N·m (45-59 ft-lb).
4. Install trim cover on base of pedestal and install three retaining screws.
5. Install seat and seat track assembly on fixed support or swivel pedestal.
6. Install four nut and washer assemblies. Tighten to 10-22 N·m (8-16 ft-lb).

#### Seat Tracks

**CAUTION: Use care when handling seat and track assembly. Dropping assembly or sitting on seat when not secured in vehicle may result in damaged components.**

#### Bench Seat—F-150—F-350 F-350 Crew Cab—F-Super Duty and Bronco

Refer to Fig. 3.

#### Removal

1. Remove the bench seat as outlined.
2. Disconnect the small tension spring from the LH seat track and the tie rod.
3. Disconnect the seat track latch tie rod from the latches on the seat tracks (Fig. 3).
4. Remove the seat track-to-seat cushion screws and remove the tracks from the cushion.
5. If the seat is being replaced, proceed to Step 1 of Installation.

#### Installation

1. Lubricate the seat track assemblies using Ford Polyethylene Grease D7AZ-19584-A or equivalent. Assemble the seat tracks to the cushion assembly (Fig. 3). Install the track-to-cushion screws and tighten to 17-27 N·m (13-19 ft-lb).

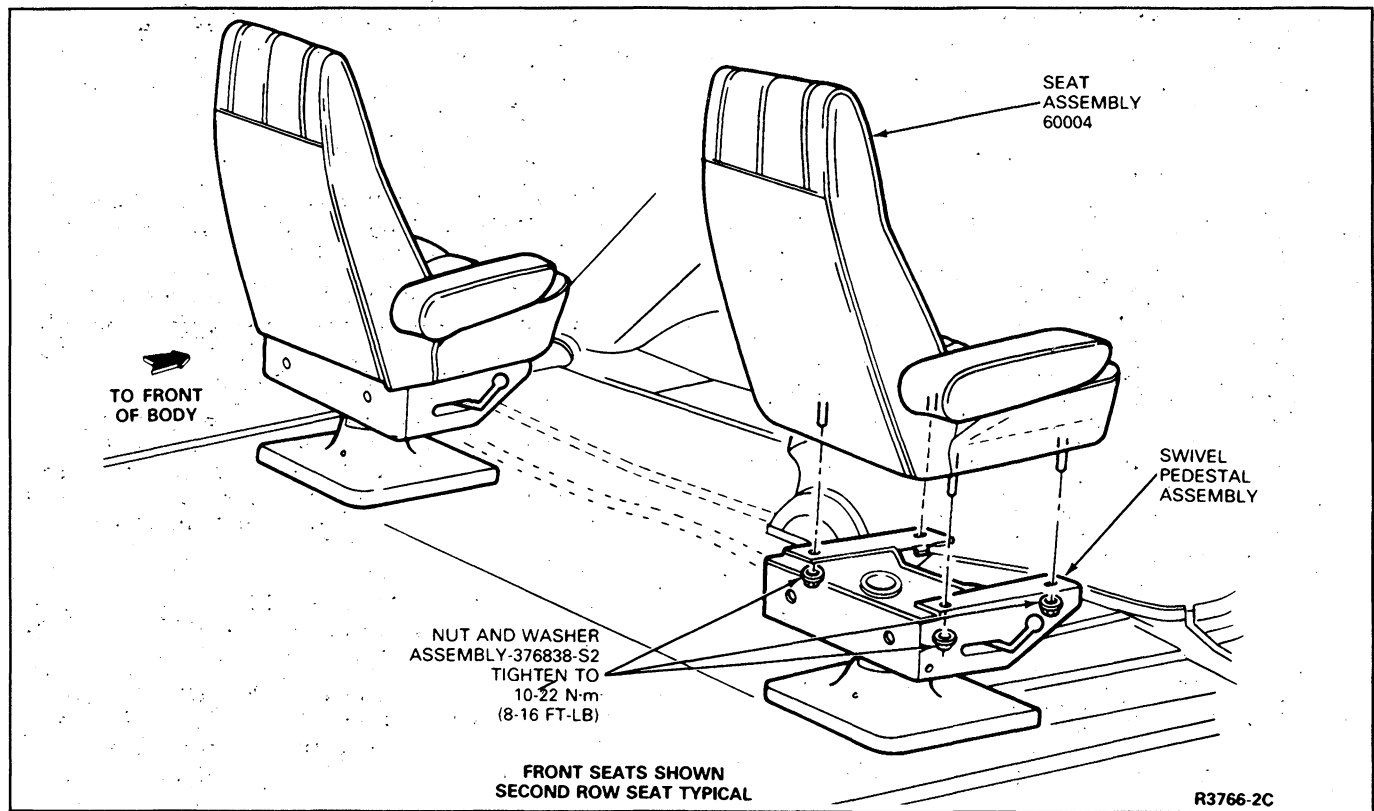


FIG. 6 E-150—E-350 Captain's Chair Seat Support—Swivel Pedestal Shown, Fixed Support Typical

2. Connect the tie rod to the latch on each seat track.
3. Connect the small tension spring to the LH seat track and the tie rod.
4. Install seat and track assembly into the vehicle as outlined.

#### Bucket Seats—E-150—E-350 Driver and Passenger

##### Removal

Refer to Fig. 4.

This procedure applies to both front seats.

1. Remove four seat track-to-support nuts and washers and lift the seat and track assembly from its support as outlined (Fig. 4).
2. Remove the track-to-seat screws and separate the seat from the track.
3. If only the seat is being replaced, proceed to Step 1 of Installation. If only the track is being replaced, remove the plastic handle and retainer from the handle lever. Remove the small spring from latch side track. Transfer all these parts to the replacement track.

##### Installation

1. Position the track assembly to the seat and secure it with the attaching screws. Tighten screws to 10-22 N·m (8-16 ft-lb).
2. Position the seat and track assembly on the support assembly and secure it with the attaching nuts and washers as outlined.

#### Bucket Seat—F-150—F-350 Super Cab and Bronco—Driver's Seat

##### Removal

Refer to Fig. 5.

1. Remove four seat track-to-floor bolts and lift the seat and track assembly from the vehicle as outlined.
2. Disconnect and remove seat track latch tie rod assembly from the latches on the seat tracks.
3. Remove track-to-seat screws and separate seat from track.
4. If only seat is being replaced, proceed to Step 1 of Installation. If only track is being replaced, remove plastic handle and metal retainer from handle lever. Remove spring from each track. Transfer all these parts to replacement tracks.

##### Installation

1. Position the track assembly to the seat and secure with attaching screws. Tighten screws to 17-27 N·m (13-19 ft-lb).
2. Install the latch tie rod to the latches on both seat tracks.
3. Apply Caulking Cord D6AZ-19560-A or equivalent around the seat track attaching bolt locations on floorpan. Install seat and track assembly into the vehicle as outlined.

#### Bucket Seat—Bronco—Passenger Seat

##### Removal

1. Remove seat assembly as outlined.



2. Remove the four bolts retaining seat assembly to the seat support.

### Installation

1. Install seat assembly to support and secure with four bolts. Tighten bolts to 17-27 N·m (13-19 ft-lb).
2. Install seat and support assembly into vehicle as outlined.

### Captain's Chair—F-150—F-350 Super Cab and Bronco—Driver Seat

Refer to Fig. 5.

### Removal

1. Remove seat and seat track assembly as outlined.
2. Disconnect and remove seat track latch tie rod assembly from the latches on the seat tracks.
3. Remove four seat track-to-seat screws and separate seat from track.
4. If only seat is being replaced, proceed to Step 1 of Installation. If only track is being replaced, remove handle assembly and retainer from lever. Remove spring from each track. Transfer all these parts to replacement tracks.

### Installation

1. Position the track assembly to the seat and secure with four attaching screws. Tighten screws to 17-27 N·m (13-19 ft-lb).
2. Install the latch tie rod to the latch on both seat tracks.
3. Apply sealer to track attaching bolt locations. Position the seat and track assembly in the vehicle as outlined.

### Captain's Chair—F-150—F-350 Super Cab and Bronco—Passenger Seat

### Removal

1. Remove the seat and support assembly as outlined.
2. Remove four bolts securing the support assembly to seat (Fig. 5).

### Installation

1. Position seat to the support assembly and secure with four bolts. Tighten bolts to 16-27 N·m (12-19 ft-lb).
2. Install seat and support into vehicle as outlined.

### Captain's Chairs E-150—E-350 and Club Wagon, Driver and Passenger

### Seat—Fixed Support and Swivel Pedestal

### Removal

Refer to Fig. 6.

1. Remove the seat and track assembly from its support as outlined.
2. Remove the four track-to-seat screws and separate the seat from the track.
3. If only the seat is being replaced, proceed to Step 1 of Installation. If only the track is being replaced, remove the plastic handle and retainer from the lever. Remove the latch spring from the latch side track. Transfer all these parts to the replacement track.

### Installation

Refer to Figs. 4 and 6.

1. Position the track assembly to the seat and secure with the four attaching screws. Tighten screws to 10-22 N·m (8-16 ft-lb).
2. Position seat and track assembly on the support and secure it with four attaching nuts and washers as outlined. Tighten nuts to 10-22 N·m (8-16 ft-lb).

### Front Seat Back Adjuster (Recliner) Actuator Cable

### Captain's Chair—F-150—F-350 Super Cab and Bronco—Passenger Seat

Refer to Fig. 5.

### Removal

1. Remove the seat and track assembly as outlined.
2. Move the seat support release handle rearward and fold the seat fully forward.
3. Remove the screw retaining the seat back adjuster actuator cable to the seat support. Then, remove the E-ring retaining the cable end to the release lever and remove the cable end (Fig. 5).
4. Remove four bolts retaining the seat support assembly to the seat spacers (Fig. 5).
5. On the recliner actuator side of the seat, remove two bolts securing the spacer to the seat cushion frame and remove the spacer.
6. Remove the seat back recliner actuator handle and bezel.
7. Remove the seat cushion trim cover hog rings. Roll back the trim cover as required to gain access to the seat back adjuster (Fig. 5).
8. Carefully peel the seat cushion pad away from the cushion frame. Then, remove the two screws retaining the seat back actuator cable to the cushion frame (Fig. 5).
9. Temporarily install the seat back adjuster actuator handle. Then, operate the seat back actuator handle, allowing the seat back to fold forward.

NOTE: In the event the seat back does not fold forward of its normal upright position when the seat back adjuster actuator handle is operated, trigger the seat back adjuster mechanism as shown in Fig. 7.

**WARNING: TO PREVENT INJURY TO THE TECHNICIAN, BEFORE REMOVING THE SEAT BACK AND ADJUSTER ASSEMBLY FROM THE SEAT CUSHION ASSEMBLY, THE SEAT BACK MUST BE FULLY FORWARD OF ITS NORMAL UPRIGHT POSITION.**

10. Remove the clip retaining the seat back to the seat cushion frame at the seat back pivot.
11. Remove the three bolts retaining the seat back adjuster to the seat cushion frame. Then, to prevent damage to the cushion trim cover, carefully remove the seat back and adjuster assembly from the seat cushion. Place the seat back on a clean surface (Fig. 5).

### Installation

1. Remove the recliner actuator handle.

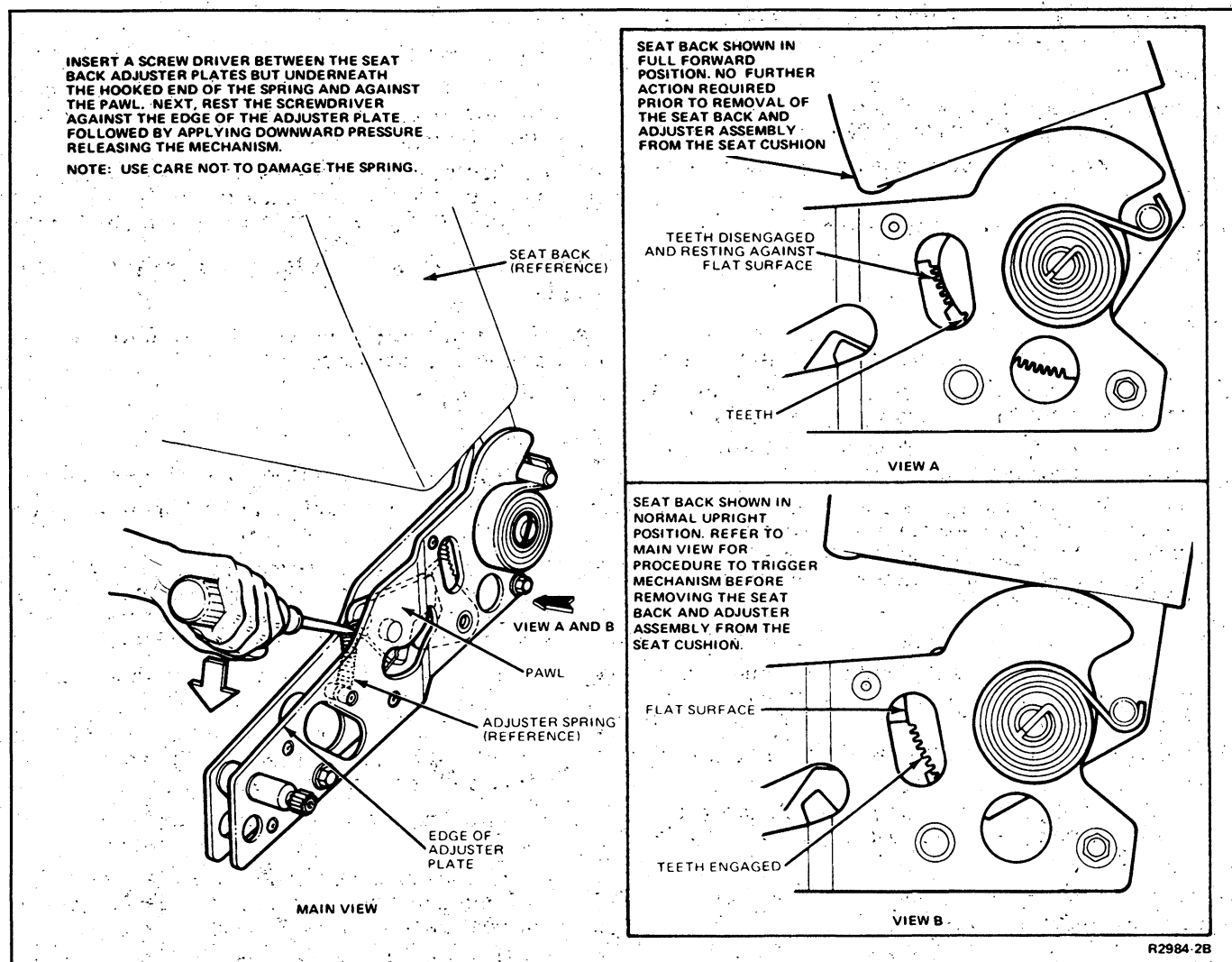


FIG. 7 Seat Back Adjuster E-150—E-350

2. Install the seat back and adjuster assembly to the seat cushion frame (three bolts). Tighten the bolts to 38-51 N·m (29-37 ft-lb) (Fig. 5).
3. Install seat back pivot pin.
4. Secure the seat back adjuster actuator cable to the seat cushion (Fig. 5).
5. Reposition and secure the cushion trim cover.
6. Install the seat spacer to the seat cushion frame. Tighten the bolts to 16-27 N·m (12-19 ft-lb) (Fig. 5).
7. Install the seat back adjuster bezel and actuator handle.

NOTE: The replacement of the seat support to seat back adjuster actuator cable (long) may require the drilling of a new attaching hole in the support assembly. Measure from the center of the seat support-to-seat spacer attaching hole to the center of the actuator cable attaching hole. If the distance is 180.9mm (7 1/8 inches) no rework is required. If not, drill a 9/64 inch diameter hole at the location shown in Fig. 5.

8. Install the support assembly to the seat spacers using the four previously removed bolts. Tighten the bolts to 16-27 N·m (12-19 ft-lb).

9. Install the end of the seat back release actuator cable into the actuator handle. Then, install the E-ring (Fig. 5).
10. Secure the actuator cable to the support assembly (Fig. 5).
11. Position the seat in an upright position. Then, push the seat back down firmly until the seat support assembly is latched.
12. Install seat into vehicle as outlined.

### E-150—E-350 Driver and Passenger Seat

#### Removal

Refer to Fig. 7.

1. Remove seat and track assembly as outlined.
2. Remove four bolts retaining the seat tracks to the seat assembly. Then, remove the seat tracks. Remove two bolts retaining the seat spacer to the cushion frame, if so equipped.
3. Remove the seat back recliner actuator handle and bezel.
4. Remove the seat cushion trim cover hog rings and roll back the trim cover as required to gain access to the seat back adjuster.

5. Carefully peel the seat cushion pad away from the cushion frame.
6. Temporarily install the seat back adjuster actuator handle. Then, operate the seat back actuator handle, allowing the seat back to fold forward of its normal upright position.

NOTE: If the seat back does not fold forward of its normal upright position when the seat back adjuster actuator handle is operated, trigger the seat back adjuster mechanism as shown in Fig. 7.

**WARNING: TO PREVENT INJURY TO THE TECHNICIAN, BEFORE REMOVING THE SEAT BACK AND ADJUSTER ASSEMBLY FROM THE SEAT CUSHION ASSEMBLY, THE SEAT BACK MUST BE FULLY FORWARD OF ITS NORMAL UPRIGHT POSITION.**

7. Remove clip retaining the seat back to the seat cushion frame at the seat back pivot.
8. Remove bolts retaining the seat back adjuster to the seat cushion frame (Fig. 5). Then, to prevent damage to the cushion trim cover, carefully remove the seat back and adjuster assembly from the seat cushion. Place the seat back on a clean surface.
9. Remove the recliner actuator handle.

#### Installation

1. Install the seat back and adjuster assembly to the seat cushion frame attaching bolts. Tighten the bolts to 38-51 N·m (29-37 ft-lb).
2. Install the seat back pivot pin.
3. Reposition and secure the cushion trim cover.
4. Install the seat spacer to the seat cushion frame using the two previously removed attaching bolts, if so equipped. Tighten the bolts to 16-27 N·m (12-19 ft-lb).
5. Install the seat back adjuster bezel and actuator handle.
6. Install the support assembly to the seat spacers using the four previously removed bolts. Tighten the bolts to 16-27 N·m (12-19 ft-lb).
7. Install the seat tracks to the seat cushion. Tighten the bolts to 10-22 N·m (8-16 ft-lb).
8. Install the seat and track assembly as outlined.

#### Seat Support

##### E-150—E-350

#### Removal

1. Remove the seat belt assembly. Refer to Section 41-50, Seat and Shoulder Belts.
2. Remove the four bolts and washers retaining the seat and support assembly to the floorpan.

#### Installation

1. Install the seat and support assembly in the vehicle. Tighten the attaching bolts to 67-81 N·m (50-59 ft-lb).
2. Install the seat belts. Tighten the bolts as outlined in Section 41-50, Seat and Shoulder Belts.

#### Fixed Support, Swivel Pedestal

##### E-150—E-350—Driver and Passenger Seat

Refer to Fig. 1 for Swivel Pedestal and Fig. 4 for Fixed Support

#### Removal

1. Remove three screws securing trim cover to the base (Swivel Pedestal only). Lift trim cover.
2. Remove four base-to-floorpan bolt and washer assemblies.
3. Lift the support (pedestal) assembly out of the vehicle.

#### Installation

1. Position the support (pedestal) assembly on the floor.
2. Apply sealer under the base, over the holes, and install four bolts and washer assemblies. Tighten the bolts to 62-81 N·m (46-59 ft-lb).
3. Position the trim cover in place and secure it with three screws (Swivel Pedestal only).

#### Seat Back Adjuster (Recliner) Captain's Chair—Driver and Passenger E-150—E-350

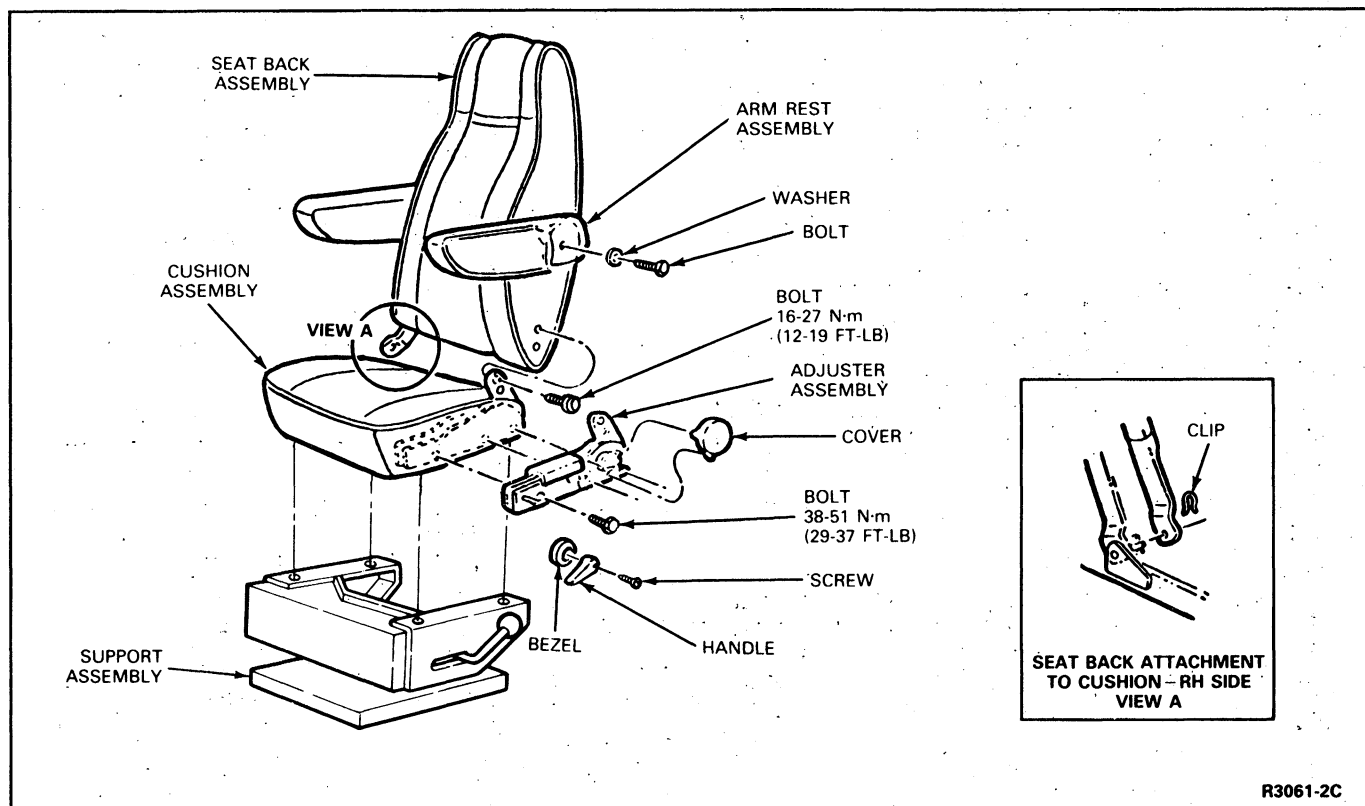
#### Removal

1. Remove the seat assembly from the vehicle as outlined.
2. Remove the seat support/seat tracks from the seat as outlined.
3. Carefully peel back the inboard armrest trim cover until the armrest-to-seat back attaching bolt is exposed (Fig. 8). Remove the bolt and place the armrest on a clean protected surface.
4. Remove the recliner actuator handle and bezel from the seat cushion (Fig. 8).
5. Remove the clip retaining the seat back to the seat cushion frame at the outboard pivot (Fig. 8, View A).
6. Remove the hog rings along the bottom of the seat back trim cover (Fig. 9).
7. Carefully peel up the seat back trim cover until the two bolts retaining the seat back to the recliner are exposed (Fig. 10).
8. Temporarily install the seat back recliner actuator handle. Then, operate the seat back actuator handle, allowing the seat back to fold forward of its normal upright position.

NOTE: In the event the seat back does not fold forward of its normal upright position when the seat back adjuster actuator handle is operated, trigger the seat back adjuster mechanism as shown in Fig. 7.

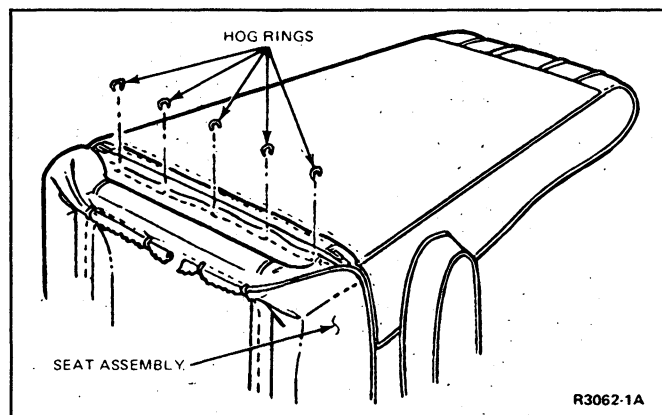
**WARNING: TO PREVENT INJURY TO THE TECHNICIAN, BEFORE REMOVING THE SEAT BACK ASSEMBLY FROM THE SEAT CUSHION ASSEMBLY, THE SEAT BACK MUST BE FULLY FORWARD OF ITS NORMAL UPRIGHT POSITION.**

9. Remove the clip retaining the seat back to the seat cushion frame at the seat back pivot.
10. After removing the two bolts retaining the seat back to the recliner assembly, lift the seat back off of the seat cushion and place it on a clean, protected surface.



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FIG. 8 Arm Rest and Pivot Retaining Clip



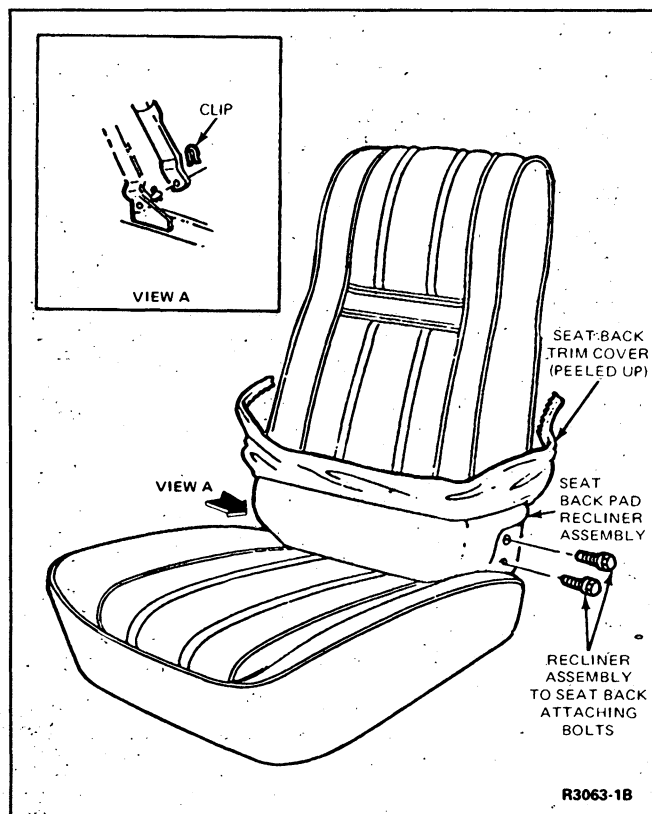
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FIG. 9 Seat Back Trim Hog Rings

11. Remove the hog rings and cushion trim cover as required to gain access to the three bolts retaining the recliner assembly to the seat cushion frame (Figs. 11 and 12).
12. Remove the three recliner assembly-to-seat cushion frame attaching bolts.
13. Remove replacement recliner assembly.

#### Installation

1. Install the recliner assembly-to-the seat cushion frame.
2. Install the three recliner assembly-to-seat cushion frame attaching bolts (Fig. 12).
3. Install the cushion trim cover to the seat cushion frame using new hog rings (Fig. 11).



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FIG. 10 Seat Back Retaining Bolts

4. Position the seat back on the recliner assembly and install the retaining bolts (Fig. 10).

5. Install the seat back to seat cushion frame using retaining clip on inboard seat back pivot (Fig. 8).
6. Move the seat back to the upright position.
7. Install the seat back trim cover using new hog rings (Fig. 9).
8. Install the seat back-to-seat cushion frame outboard pivot retaining clip (Fig. 8).
9. Install the recliner actuator handle and bezel on the seat cushion (Fig. 8).
10. Position the inboard armrest and install the retaining bolt. Install the armrest cover (Fig. 8).
11. Install the seat support/seat tracks as outlined.
12. Install the seat assembly as outlined.

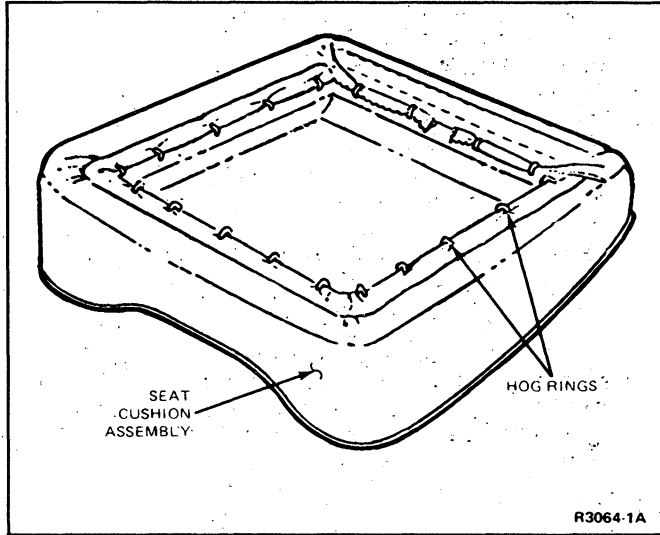


FIG. 11 Seat Cushion Hog Rings

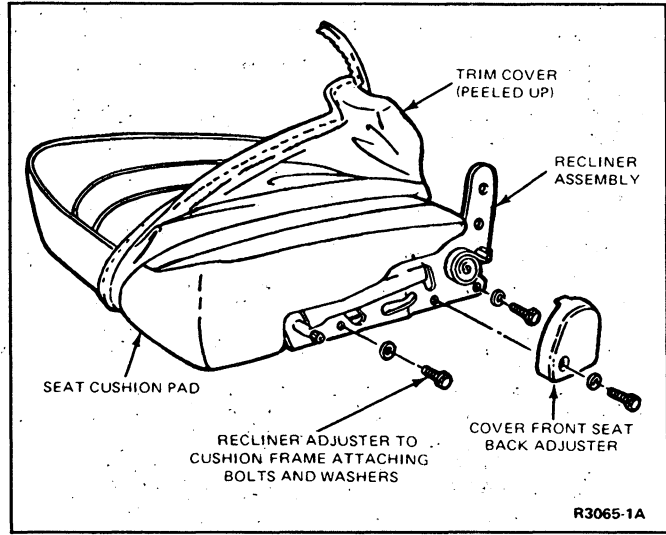


FIG. 12 Recliner Assembly

## SPECIFICATIONS

### SEAT TRACK — MANUAL — TORQUE N-m (FT-LB)

Vehicle	Seat Track-to-Cushion		Seat Track-to-Floor Pan or Support			Support-to-Floor	
	Bench	Bucket	Captains	Bench	Bucket	Captains	Bucket
Econoline	—	10-22 (8-16)	10-22 (8-16)	—	10-22 (8-16)	61-81 (45-59)	61-81 (45-59)
F-Series & Bronco	17-27 (13-19)	17-27 (13-19)	25-44 (19-32)	25-44 (19-32)	25-44 (19-32)	61-81 (45-59)	—

CR2206-2G

# SECTION 41-14 Conventional Rear Seats

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION .....	41-14-1	REMOVAL AND INSTALLATION (Cont'd)	
REMOVAL AND INSTALLATION		Rear Compartment Seat and Seat Belt—	
Quick Release Seat—3-Passenger—E-150—		Four Passenger Seat—E-150—E-350 .....	41-14-1
E-350 .....	41-14-1	Seat Tracks .....	41-14-2
Rear Bench Seat .....	41-14-2	Rear Bench Seat F-350 Crew Cab .....	41-14-2
F-350 Crew Cab .....	41-14-2	VEHICLE APPLICATION .....	41-14-1

## VEHICLE APPLICATION

E-150—E-350 And F-350 Crew Cab.

## DESCRIPTION

On E-series, the 3-Passenger Quick Release Rear Seat is held to the floor by the engagement of the rear retainer with the rear striker and the engagement of a latch rod hook with the front striker. The Quick Release facilitates removal of the rear seat.

## REMOVAL AND INSTALLATION

### Quick Release Seat—3-Passenger—E-150—E-350

#### Removal

1. Lift and rotate the seat latch handles (RH and LH) rearward, causing the seat to move rearward and disengage the floor strikers (Fig. 1).
2. Lift the latch rod hook end (RH and LH) out of the locking holes in the front floor strikers.

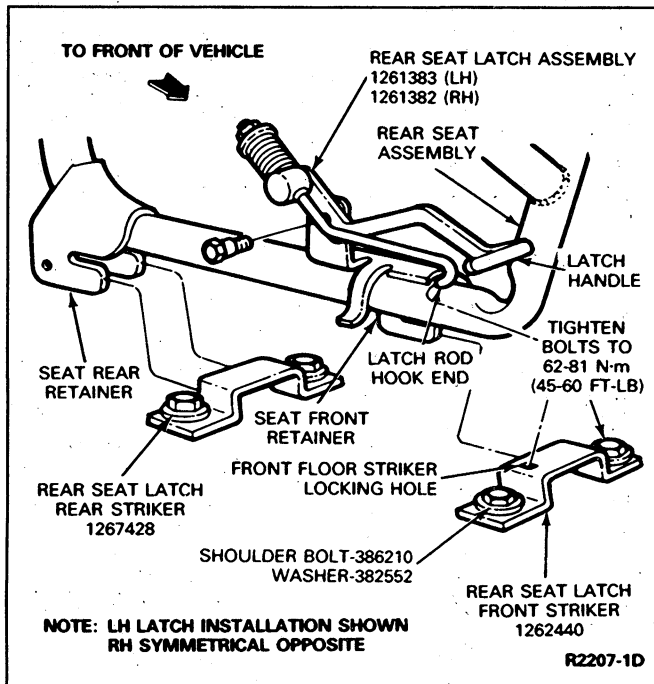


FIG. 1 Optional Quick Disconnect for 3-Passenger Rear Seat E-150—E-350

3. Remove the seat assembly from the vehicle.

4. If floor strikers are to be removed:

Remove striker attaching bolts and washers. Apply a bead of Ford Caulking Cord D6AZ-19560-A or equivalent to the floorpan side of the washers. Install the bolts and washers into the floor and tighten the seat striker bolts to 14-27 N·m (10-20 ft-lb).

#### Installation

1. If floor strikers were removed, install strikers, bolts and washers. Tighten the bolts to 62-81 N·m (45-60 ft-lb). The front strikers have holes to be positioned inboard for latch engagement.
2. Lift the seat assembly into the vehicle and align the retainers to the rear edge of the floor strikers (Fig. 1).
3. Engage the hook end of the latch rods (RH and LH) into the front floor striker locking hole.
4. Rotate the latch handles (RH and LH) forward, causing the seat assembly to slide forward into engagement with the floor strikers. Continue latch handle rotation until the bottom of the handle contacts the top surface of the front floor strikers.

NOTE: In Club Wagons with eight passenger seating, the bench seat with automatic locking seat belt retractors at the outboard positions must be installed in the first bench seat position.

**WARNING: KEEP STRIKER AREA FREE OF FOREIGN OBJECTS THAT WOULD PREVENT FRONT AND REAR RETAINERS FROM PROPERLY ENGAGING THE STRIKERS. NEVER ATTEMPT TO ADJUST THE SEAT LATCH WHILE THE VEHICLE IS IN MOTION. PRIOR TO OCCUPYING THE SEAT, CHECK TO SEE THAT THE HOOK END OF THE LATCH RODS AND HANDLES ARE LATCHED SECURELY TO THE STRIKERS TO ENSURE PROPER SEAT RETENTION.**

### Rear Compartment Seat and Seat Belt—Four Passenger Seat—E-150—E-350

To remove a rear compartment seat and floor attaching seat belts, remove each bolt and lock washer (Figs. 2 and 3). Remove the seat and belts. Apply a bead of putty-like waterproof sealer, such as Ford Caulking Cord D6AZ-19560-A or equivalent, to the floorpan side of the washers. Install the bolts and washers in the floor. Tighten the seat bolts to

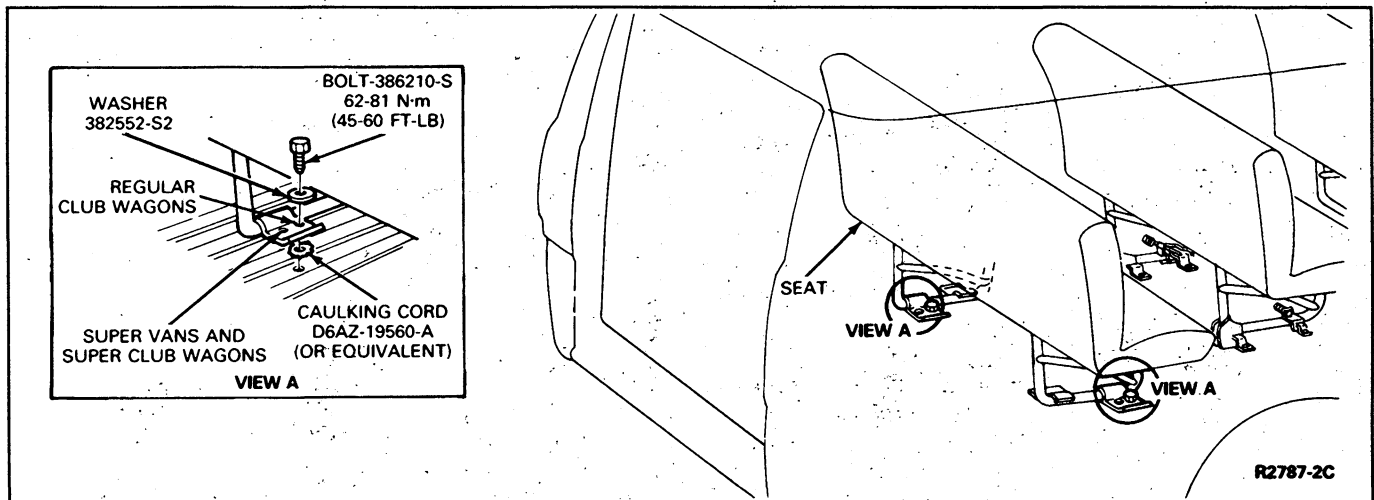


FIG. 2 Rear Four Passenger Seat—Fourth Row—E-150—E-350 (12-passenger)

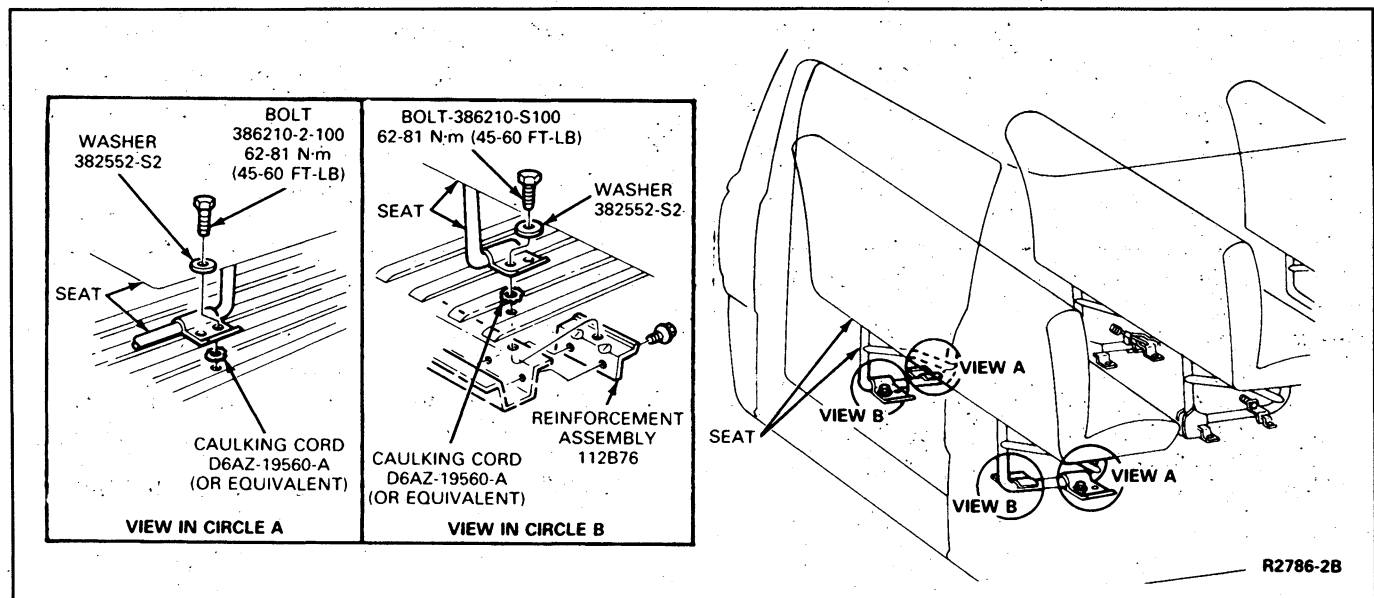


FIG. 3 Rear Four Passenger Seat—Fifth Row—E-150—E-350 (15-passenger)

34-61 N·m (25-45 ft-lb) and the seat belt bolts to 14-29 N·m (10-22 ft-lb).

To install the seat and belts, use the same sealing procedure. Tighten the seat mounting bolts to 62-81 N·m (45-60 ft-lb) and seat belt mounting bolts to 30-43 N·m (22-32 ft-lb).

**NOTE:** In Club Wagons with eight passenger seating, the bench seat with automatic locking retractors at the outboard positions must be installed in the first bench seat position.

## Rear Bench Seat

### F-350 Crew Cab

#### Removal

1. Remove the seat track-to-floorpan retaining screws (two on each side) and lift the seat and track assembly out of the vehicle (Fig. 4).

#### Installation

1. Apply Caulking Cord D6AZ-19560-A or equivalent under seat track assembly.

2. Lift the seat and track assembly into the cab and secure it to the floorpan with the retaining screws. Tighten the screws to 25-44 N·m (18-32 ft-lb).

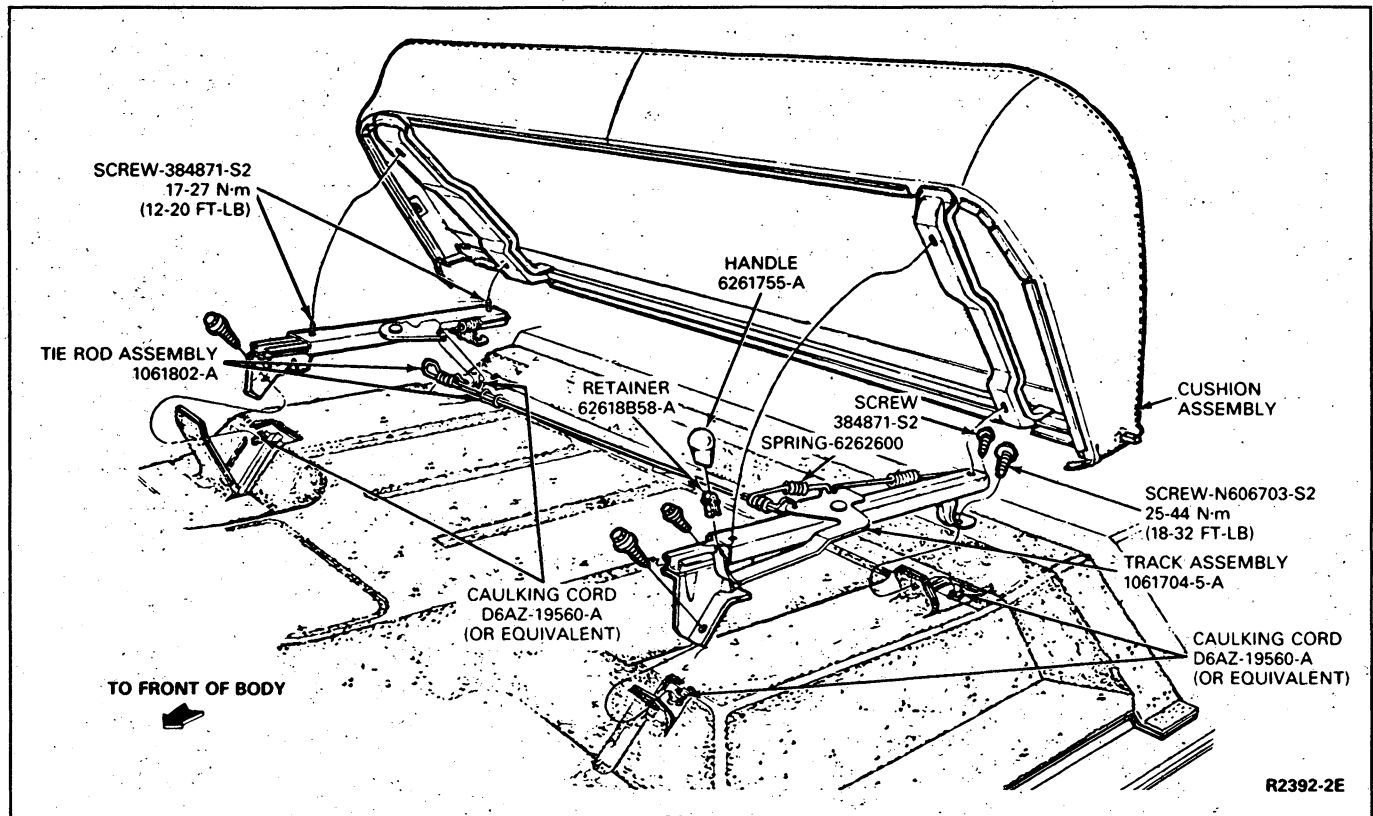
## Seat Tracks

### Rear Bench Seat F-350 Crew Cab

#### Removal

1. Remove the bench seat as outlined.
2. Disconnect the small tension spring from the LH seat track and the tie rod.
3. Disconnect the seat track latch tie rod from the latches on the seat tracks (Fig. 4).
4. Remove the seat track-to-seat cushion screws and remove the tracks from the cushion.

**CAUTION:** Use care when handling a seat and track assembly. Dropping assembly or sitting on seat when not secured in vehicle may damage seat track components.



**FIG. 4 Rear Bench Seat and Track Installation—F-350 Crew Cab**

#### Installation

1. Lubricate the seat track assemblies using Multi-Purpose Grease D0AZ-19584-AA or equivalent. Assemble the seat tracks to the cushion assembly (Fig. 4). Install the track-to-cushion screws and tighten to 17-27 N·m (12-20 ft-lb).
2. Connect the tie rod to the latch on each seat track.
3. Connect the small tension spring to the LH seat track and the tie rod.
4. Install seat and track assembly as outlined.



# SECTION 41-20 Folding Rear Seats

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION</b>	
E-150—E-350 Seat/Bed Center Latch .....	41-20-1	E-150—E-350 Seat/Bed Tie Rod .....	41-20-1
E-150—E-350 Seat/Bed Operation .....	41-20-1	Front Cushion and Armrest Assembly .....	41-20-1
E-150—E-350 Seat/Bed Tie Rod .....	41-20-1	Rear Deck .....	41-20-1
<b>DESCRIPTION AND OPERATION</b>		Seat Back .....	41-20-1
Bronco .....	41-20-1	Seat/Bed Assembly .....	41-20-2
E-150—E-350 .....	41-20-1	<b>VEHICLE APPLICATION</b> .....	41-20-1
Super Cab .....	41-20-1		

## VEHICLE APPLICATION

F-150 Through F-350 with Super Cab, Bronco and E-150 Through E-350.

## DESCRIPTION AND OPERATION

### Super Cab

Super Cab models have optional folding side-mounted rear seats which are designed to fold upward against the side of the cab for storage (Fig. 1). A forward-facing folding rear seat which converts to a load floor is optional with F-150 and F-350 Super Cab models (Fig. 2). The back of the seat is held in an upright position by a latch mounted on the inside rear of the cab (Fig. 3). The bottom of the seat pivots to lie flat against supporting bumpers (Fig. 4).

### Bronco

The Bronco has an optional fold-down rear seat (Fig. 5). A seat back latch on the lower RH side of the rear seat is lifted to unlock the seat back. The seat back is folded to the cushion with an additional seat back lever. A cushion latch located at the center rear of the cushion is lifted to unlock the cushion from the floor-mounted striker. The cushion folds forward to provide a flat storage area.

### E-150—E-350

E-150 through E-350 models have an optional rear seat/bed (Fig. 6). A latch is provided to convert the seat to a bed.

## ADJUSTMENTS

### E-150—E-350 Seat/Bed Tie Rod

If the seat/bed latch fails to release, turn the adjusting turnbuckle clockwise to shorten the rod travel (Fig. 6). If the seat fails to lock in the bed position, turn the adjusting turnbuckle counterclockwise to lengthen the rod travel.

### E-150—E-350 Seat/Bed Center Latch

If the seat/bed center latch does not return to the locked position after operation of seat/bed, move latch adjusting spring toward the center of the seat/bed (Fig. 6).

### E-150—E-350 Seat/Bed Operation

If the seat/bed operation becomes difficult, loosen four cushion attaching bolts and allow seat/bed to shift (Fig. 6). Tighten attaching nuts. Check operation effort. Tighten upper seat back attachment to 11-21 N·m (8-16 ft-lb).

## REMOVAL AND INSTALLATION

### E-150—E-350 Seat/Bed Tie Rod

#### Front Cushion and Armrest Assembly

##### Removal

1. Detach rear latch wire from the front latch (Fig. 6).
2. Remove four nuts attaching seat cushion to frame assembly.
3. Remove seat cushion from frame assembly.

##### Installation

1. Position seat cushion to frame assembly (Fig. 6).
2. Secure cushion to frame assembly with four nuts. Tighten nuts to 17-27 N·m (12-20 ft-lb).
3. Attach rear latch wire to front latch.

#### Seat Back

##### Removal

1. Remove seat cushion as outlined.
2. Remove four bolts and nuts attaching the seat back to the frame assembly (Fig. 6).
3. Remove seat back from the frame assembly.

##### Installation

1. Position seat back to the frame assembly (Fig. 6).
2. Install attaching screws and tighten to 11-21 N·m (8-16 ft-lb).

NOTE: Cross tighten attaching screws to ensure proper seat/bed operation.

3. Install seat cushion as outlined.

#### Rear Deck

##### Removal

1. Loosen wing nuts on each side of rear deck (Fig. 6).
2. Slide rear deck off the frame assembly.

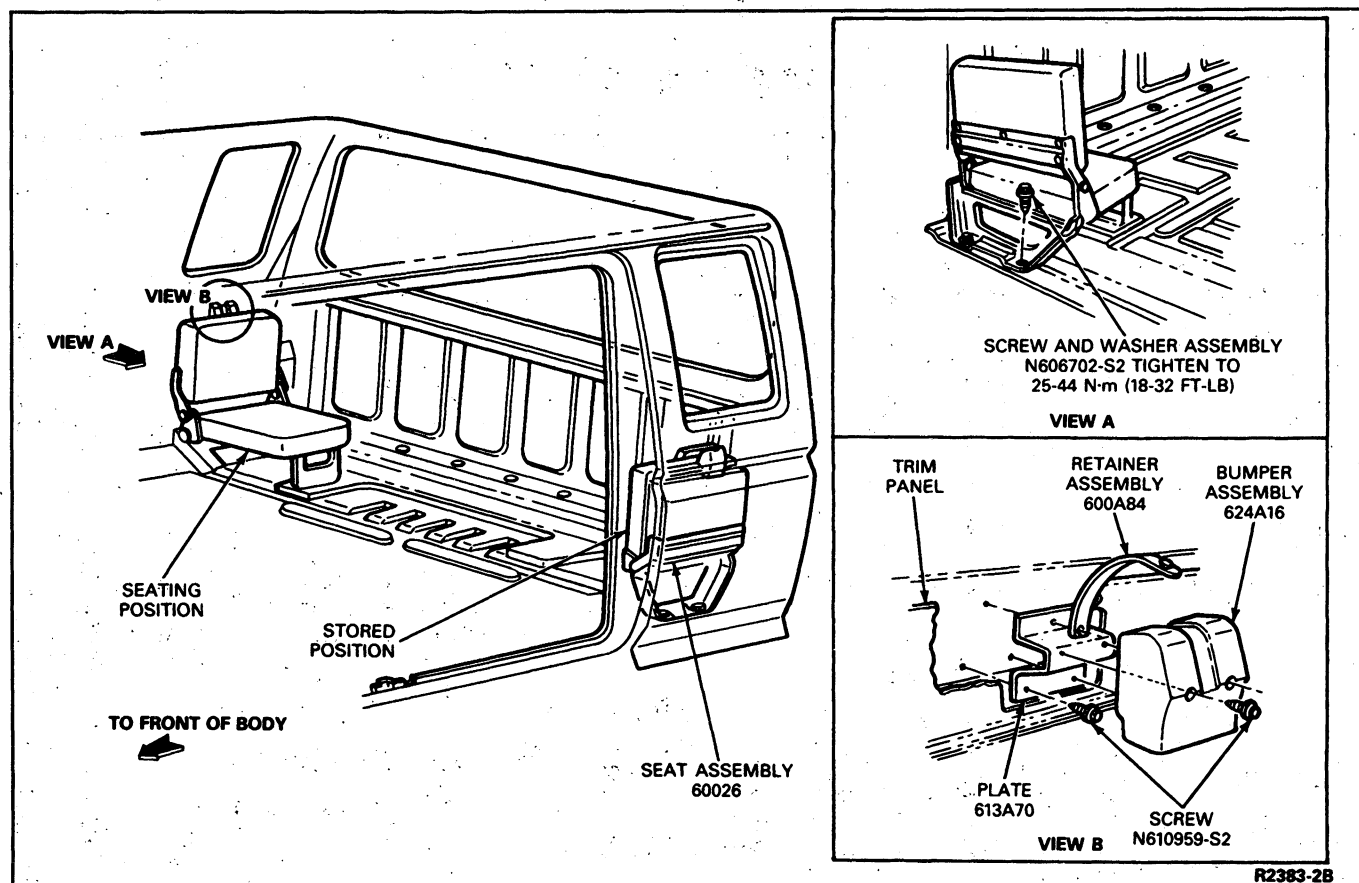


FIG. 1 Side-Mounted Folding Rear Seats—F-150—F-350 Super Cab

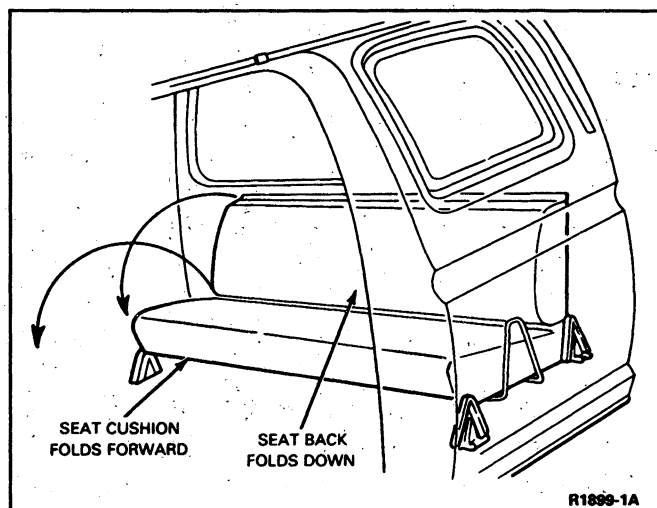


FIG. 2 Forward-Facing Folding Rear Seat—F-150—F-350 Super Cab

#### Installation

1. Slide rear deck into place on frame assembly (Fig. 6).
2. Secure with wing nut on each side.

#### Seat/Bed Assembly

#### Removal

1. Remove rear deck from assembly as outlined.
2. Remove the seat belts. Refer to Section 41-50, Seat and Shoulder Belts.
3. Remove four bolts attaching seat/bed to floor (Fig. 6).
4. Remove seat/bed assembly from vehicle through the rear door.

#### Installation

1. Position seat/bed assembly on floor.
2. Secure with attaching bolts. Tighten attaching bolts to 62-81 N·m (45-60 ft-lb).
3. Install the seat belts. Tighten the attaching bolts to 30-43 N·m (22-32 ft-lb).
4. Install rear deck as outlined.

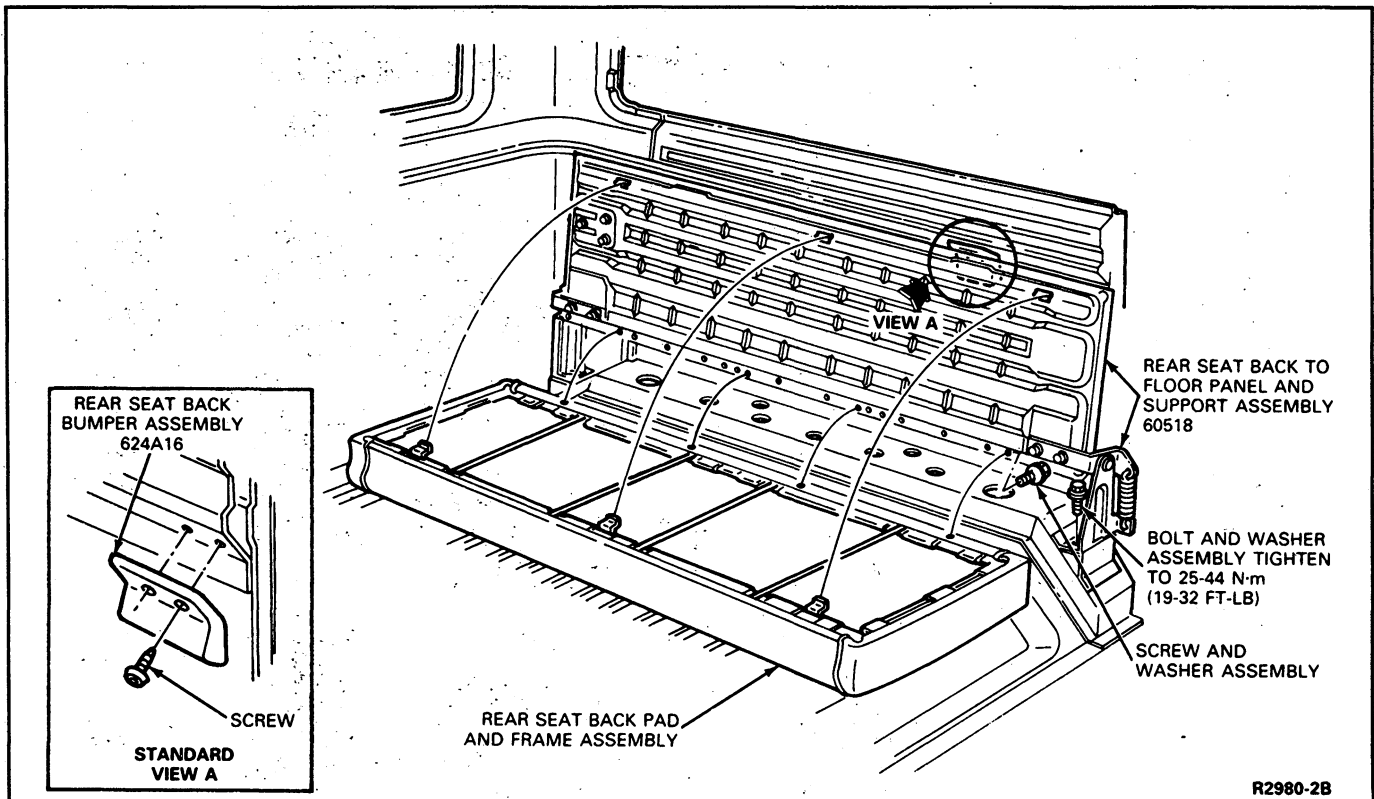


FIG. 3 Forward-Facing Rear Seat Back Installation—F-150—F-350 Super Cab

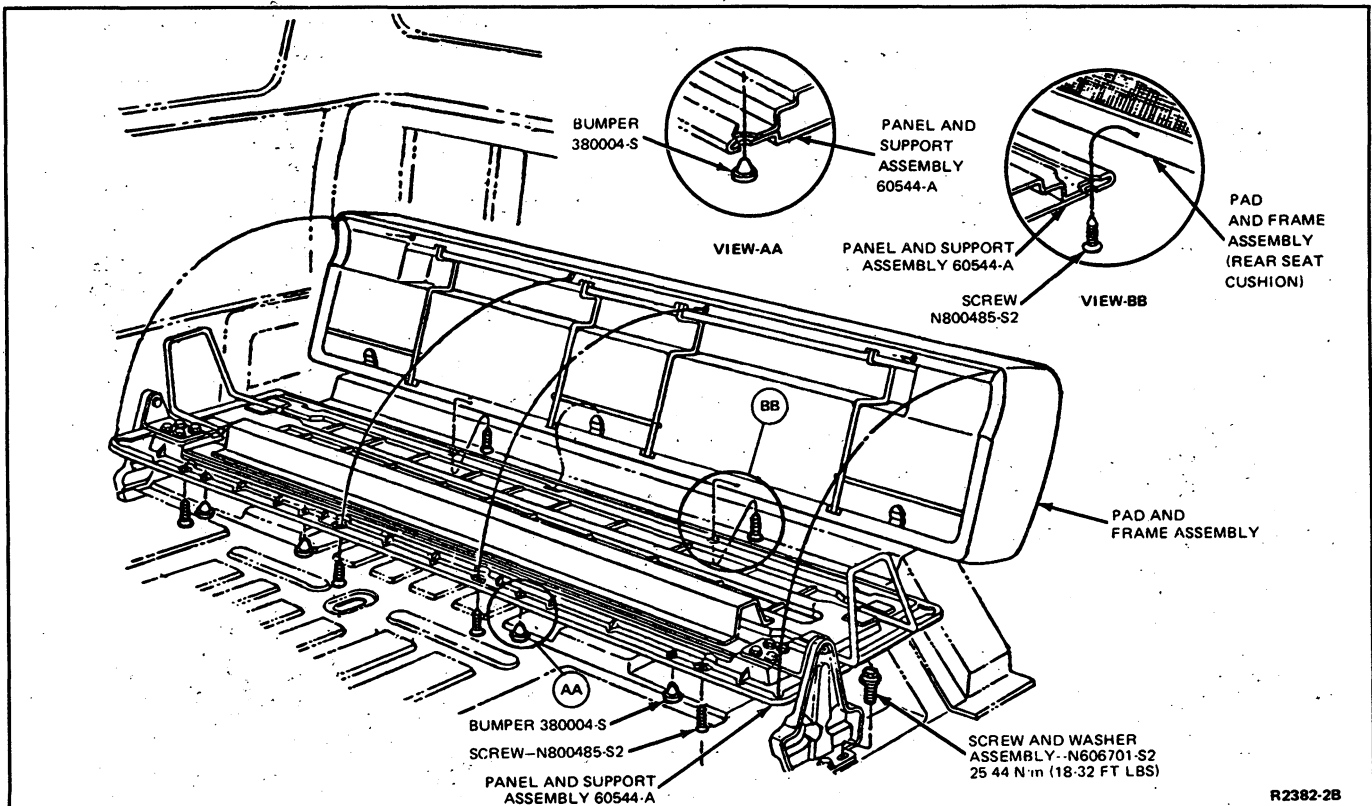


FIG. 4 Forward-Facing Rear Seat Cushion Installation—F-150—F-350 Super Cab

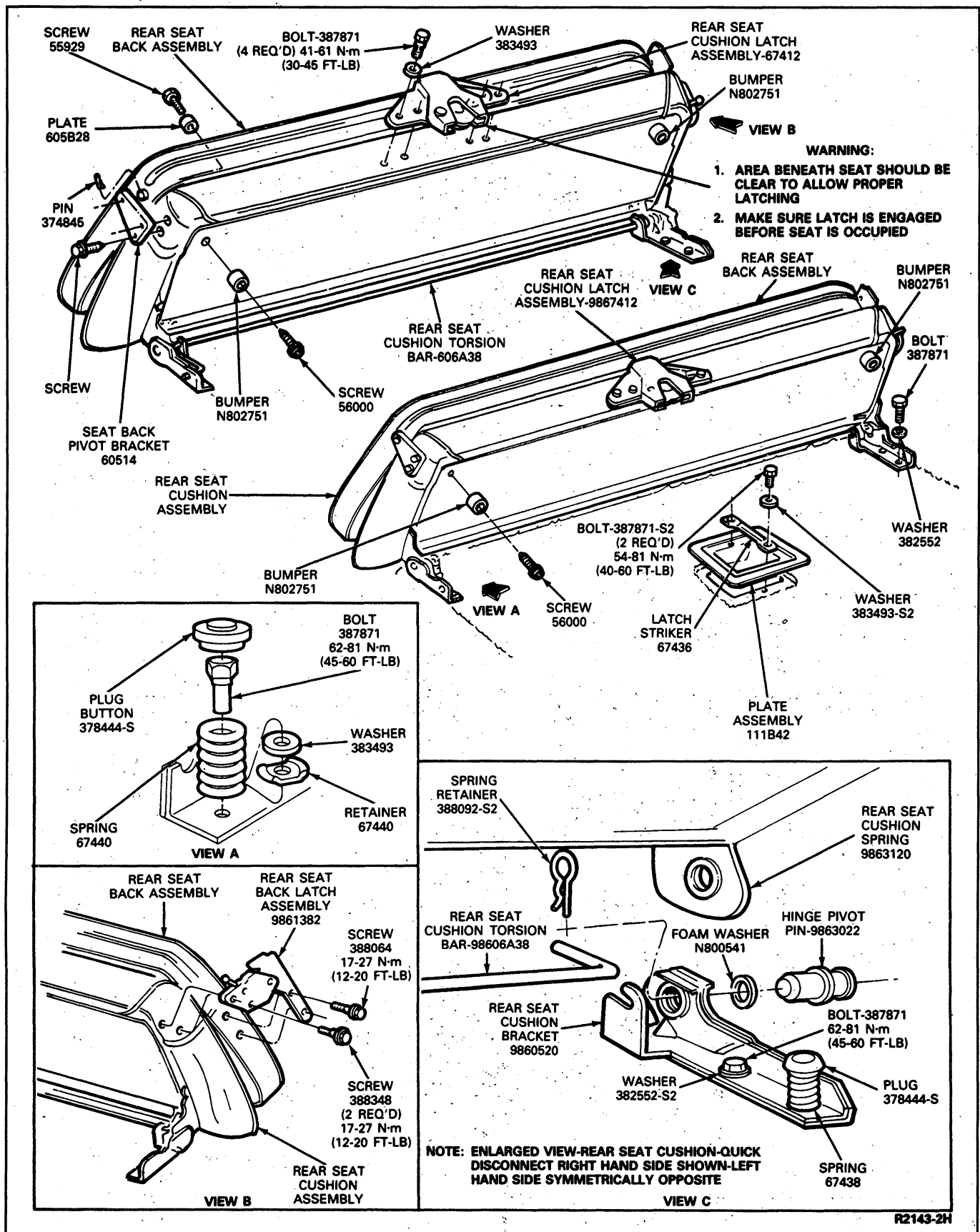


FIG. 5 Rear Fold Down Seat—Bronco

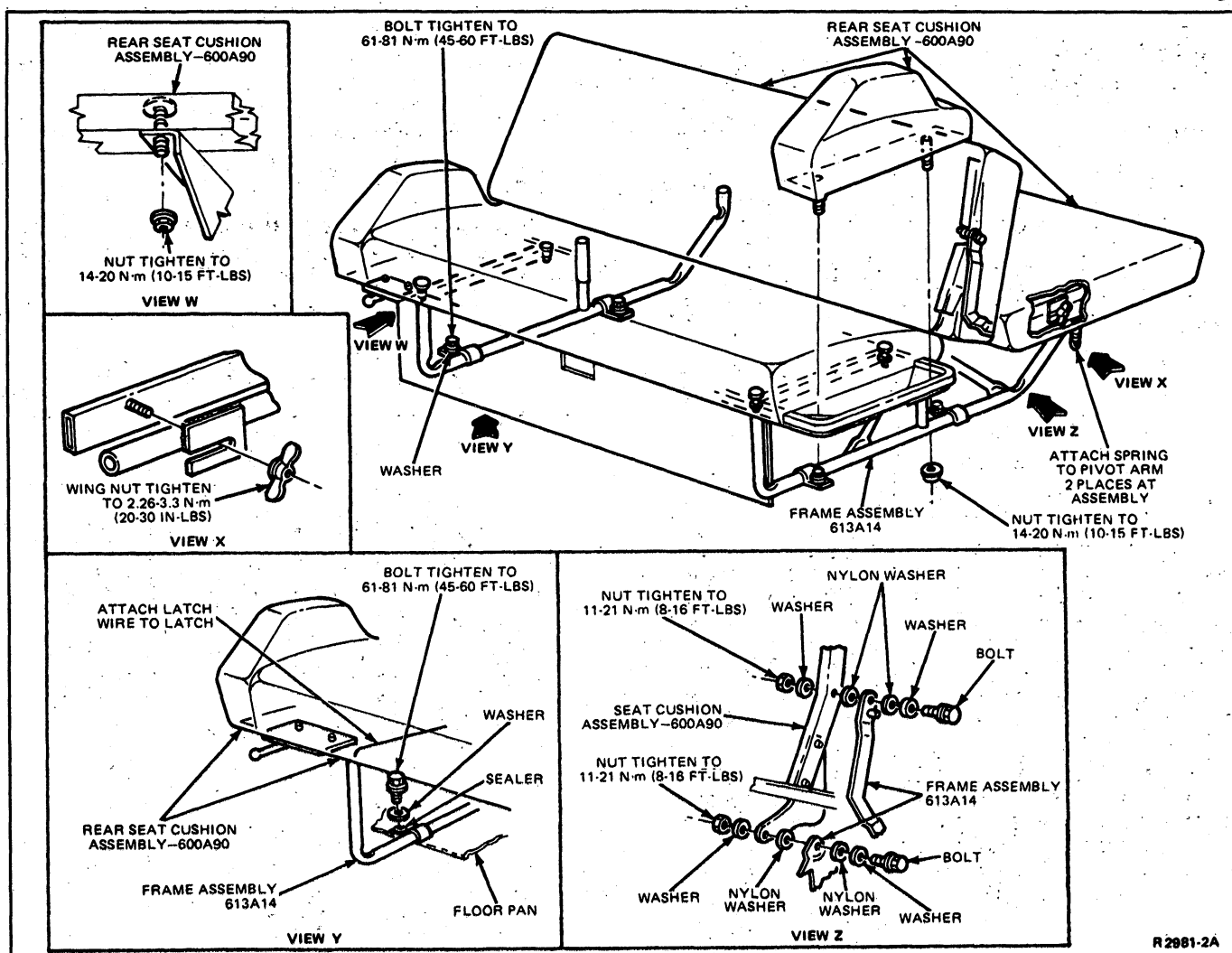


FIG. 6 Rear Seat/Bed—E-150—E-350

# SECTION 41-25 Seat Back Latch

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION .....	41-25-1	REMOVAL AND INSTALLATION (Cont'd)	
REMOVAL AND INSTALLATION		F-350 Crew Cab Rear Seat Latch .....	41-25-2
Bronco and F-150—F-350 Super Cab		Striker .....	41-25-2
Bench Seat Latch .....	41-25-1	VEHICLE APPLICATION .....	41-25-1
F-150—F-350 Bench Seat Latch .....	41-25-1		

## VEHICLE APPLICATION

F-150—F-350 and Bronco.

## DESCRIPTION AND OPERATION

All folding seats (except Bronco passenger seat on models with bucket seats) have a latch designed to hold the seat back in the normal position. The Bronco bucket seat back does not fold forward on the passenger side. For rear seat passenger entry and exit and to gain access to the storage compartment. (F-150—F-350 Super Cab, F-350 Crew Cab and Bronco with full bench seat), a handle on the side of the seat back releases the seat latch.

If the seat back will not latch in position or the latch mechanism will not unlock, it may be necessary to remove the side shield and/or remove the seat back trim cover far enough to inspect the latch mechanism. Then, replace any parts to put the latch system in proper working order (Figs. 1 and 2).

For information on the seat back latch used with forward-facing rear seat option (Super Cab only), refer to Section 41-20 Folding Rear Seats.

## REMOVAL AND INSTALLATION

### F-150—F-350 Bench Seat Latch

#### Removal

1. Remove attaching screws and trim shield from lower side of seat back (both sides) (Fig. 2).
2. Remove two bolts attaching latch to seat back.

#### Installation

1. Install two attaching bolts. Ensure that springs (one each side) rest against the bottom of the seat back and are hooked over the pawls on each end of the latch. Tighten upper bolt to 25-37 N·m (18-28 ft-lb) and the lower bolt to 25-34 N·m (18-32 ft-lb).
2. Install trim cover using cover attaching screw (Fig. 2).

### Bronco and F-150—F-350 Super Cab Bench Seat Latch

#### Removal

1. Remove bolt and washer attaching seat back to cushion and remove back from vehicle (Fig. 1).
2. Untrim back to gain access to latch mechanism. Refer to Section 41-60, Seat Trim.

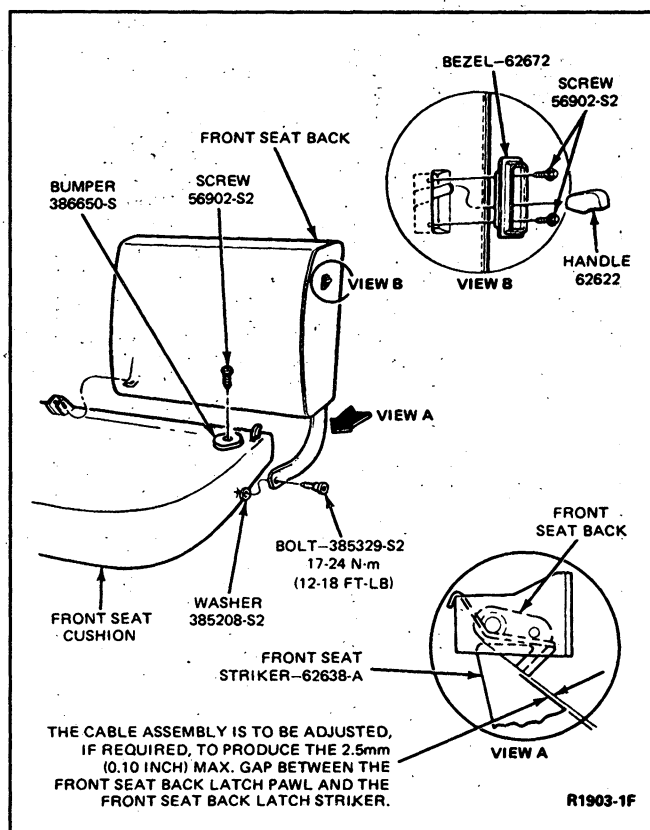
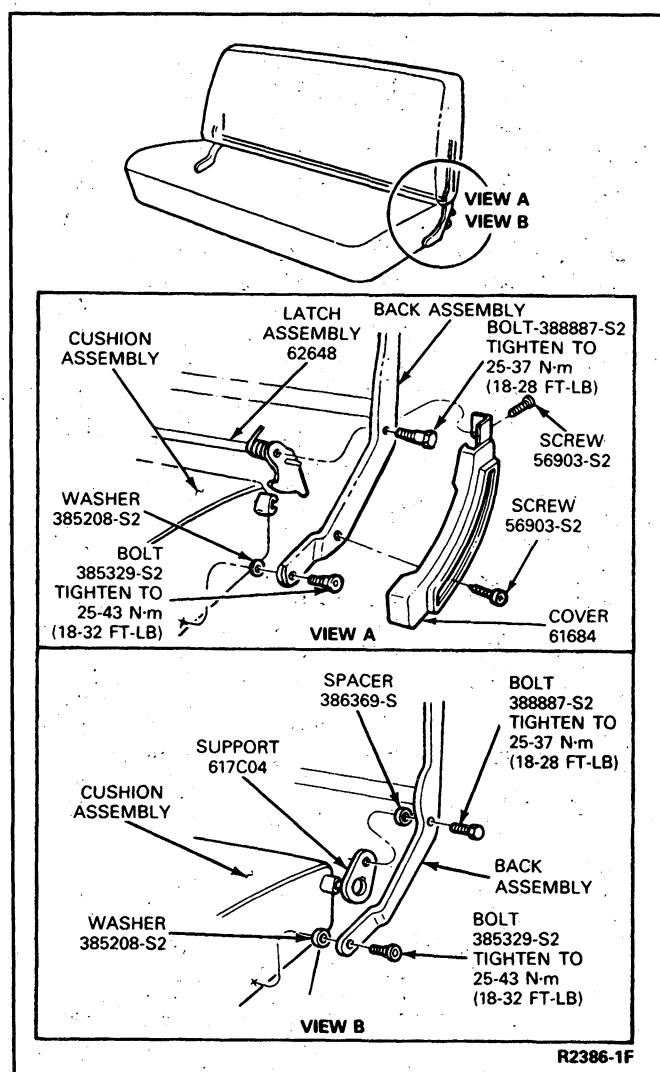


FIG. 1 Front Seat Back Latch Installation—Bronco and F-150—F-350 Super Cab Models

3. To remove the rod assembly connecting the unlatching lever to the latch pawl, remove two screws and bundling strap. Unhook rod from lever and pawl.
4. To remove the latch pawl, disconnect the rod from the pawl. Cut and remove the pawl pivot pin and disconnect spring from seat back frame.

#### Installation

1. To install latch pawl, insert a new pivot pin through holes in seat back and pawl. Flatten end of pin to retain it in the seat frame and hook end of spring onto seat frame. Insert end of latch rod through hole in pawl.
2. To install the latch rod, push attachment screws through holes in attaching tabs on rod and install to seat frame. Insert ends of rod into proper holes in the lever and pawl.



**FIG. 2 Front Seat Back Latch Installation—F-150—  
F-350 Conventional Cab Bench Seat**

3. Install untrimmed seat back frame to cushion and adjust gap between pawl and striker by rotating center portion of the rod assembly. The gap between the pawl and striker must be 1.27-1.77mm (0.05-0.07 inch). Remove seat frame from cushion and retrim.
4. Install trimmed seat back to cushion by inserting attaching bolt through hole at end of the arm sticking out of the trimmed back. Slide washer over the end of the bolt, slide back onto inboard pivot pin and drive attachment bolt. Tighten bolt to 25-43 N·m (18-32 ft-lb). Check gap and adjust if necessary.

## Striker

## Removal

1. Dump seat back forward.
2. Untrim rear corner of seat cushion.
3. Remove two attaching bolts and striker from seat cushion (Fig. 1).

## Installation

1. Install two attaching bolts and tighten to 17-27 N·m (12-20 ft-lb).
2. Retrim rear corner of seat cushion.
3. Adjust gap between pawl and striker by reaching up inside trimmed back and rotating latch rod adjustment until gap is 1.27-1.77mm (0.05-0.07 inch).

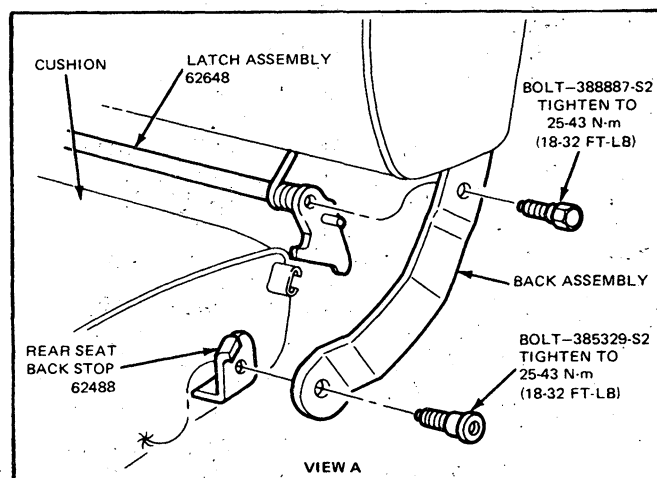
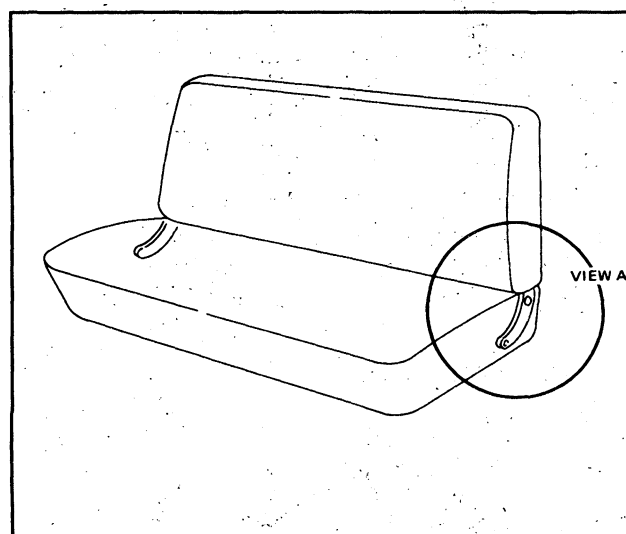
## F-350 Crew Cab Rear Seat Latch

## Removal

1. Remove two bolts attaching latch to seat back (Fig. 3).

## Installation

1. Install two attaching bolts. Ensure that springs (one each side) rest against the bottom of the seat back and are hooked over the pawls on each end of the latch. Tighten bolts to 25-43 N·m (18-32 ft·lb).



**FIG. 3 Rear Seat Back Latch Installation—F-350 Crew Cab**

# SECTION 41-50 Seat and Shoulder Belts

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>MAJOR REPAIR OPERATIONS (Cont'd)</b>	
Jammed Lap Belt Retractor Two-Point Systems .....	41-50-4	Lap Belt Retractor Test—(Two-Point System) .....	41-50-7
Rear Belts .....	41-50-4	Seat and Shoulder Belts .....	41-50-7
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<b>DESCRIPTION AND OPERATION</b>		Seat Belt with No Anchor Plate Thread Damage .....	41-50-7
Center Lap Belts .....	41-50-4	<b>REMOVAL AND INSTALLATION</b>	
Continuous Loop System Description .....	41-50-2	Seat Belts .....	41-50-5
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Seat Belt Extension Assembly .....	41-50-1	Bronco—Front Bucket Seats .....	41-50-5
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Two-Point Lap Belt Operation—Non-Retractor .....	41-50-3	F-150—F-350 Super Cab .....	41-50-6
Two-Point Lap Operation—Retractor .....	41-50-3	<b>SPECIFICATIONS</b> .....	41-50-13
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<b>DIAGNOSIS</b> .....	41-50-9	Lap Belt Retractor Does Not Lock .....	41-50-5
<b>MAJOR REPAIR OPERATIONS</b>		Webbing Cannot be Pulled from Lap Belt Retractor .....	41-50-4
Continuous Loop Shoulder/Lap Belt Test—(System with Movable Tongue and One Retractor) .....	41-50-7	<b>VEHICLE APPLICATION</b> .....	41-50-1
Damaged Anchor Plate Threads Functional Test Procedure .....	41-50-7		

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350, F-Super Duty and Bronco.

## DESCRIPTION AND OPERATION

The seat belts and shoulder belts are factory-installed in their proper locations. If the seat belts or shoulder belts are removed for any reason, they should be installed as shown in Figs. 1 through 10. Sealer should be placed around all seat belt anchor bolt holes in the floorpan. Tighten the anchor bolts to 30-43 N·m (22-32 ft-lb).

Belt assemblies must be installed in matched sets as received and **must not be interchanged between vehicle models.**

If a component portion (buckle portion, retractor portion, etc.) of a seat belt or shoulder belt assembly is nonfunctional or damaged, the entire assembly (buckle, tongue and shoulder harness portions) must be replaced. The replacement assembly must be installed as a matched set and the identification labels on all portions must bear exactly the same code, date of manufacture and manufacturer's name. **Under no circumstances are seat belt or shoulder belt components to be replaced as individual components.**

**WARNING: ALL SAFETY BELT ASSEMBLIES INCLUDING RETRACTORS AND ATTACHING HARDWARE SHOULD BE INSPECTED AFTER ANY COLLISION. FORD RECOMMENDS THAT ALL SAFETY BELT ASSEMBLIES IN USE DURING A COLLISION BE REPLACED UNLESS THE COLLISION WAS MINOR AND A QUALIFIED**

**TECHNICIAN FINDS THAT THE BELTS SHOW NO DAMAGE AND CONTINUE TO OPERATE PROPERLY. SAFETY BELT ASSEMBLIES NOT IN USE DURING A COLLISION SHOULD ALSO BE INSPECTED AND REPLACED IF EITHER DAMAGE OR IMPROPER OPERATION IS NOTED.**

## Seat Belt Extension Assembly

A seat belt assembly that is too short when fully extended over the lap of a stocky vehicle occupant, can be lengthened approximately 203mm (8 inches) with a seat belt extension assembly which can be obtained through local Ford Dealers. The seat belt extension assembly is only available with black webbing and standard buckle and must be of the same manufacture as the belt system to which it is attached.

## Occupant Restraint System

The continuous loop system can be identified by the movable tongue on the front outboard lap/shoulder belt and only one retractor. (This is a combination lap/shoulder belt retractor.)

## Seat Belt Warning System

Continuous loop system units incorporate a buzzer and lamp warning system. The seat belt warning lamp will illuminate for approximately eight seconds after the ignition switch is turned to the RUN position, regardless of seat belt usage. The seat belt warning buzzer is grounded by a switch in the LH inboard buckle, on the continuous loop and the dual spool systems. The seat belt warning buzzer will sound for approximately eight seconds unless the driver's belt is used.



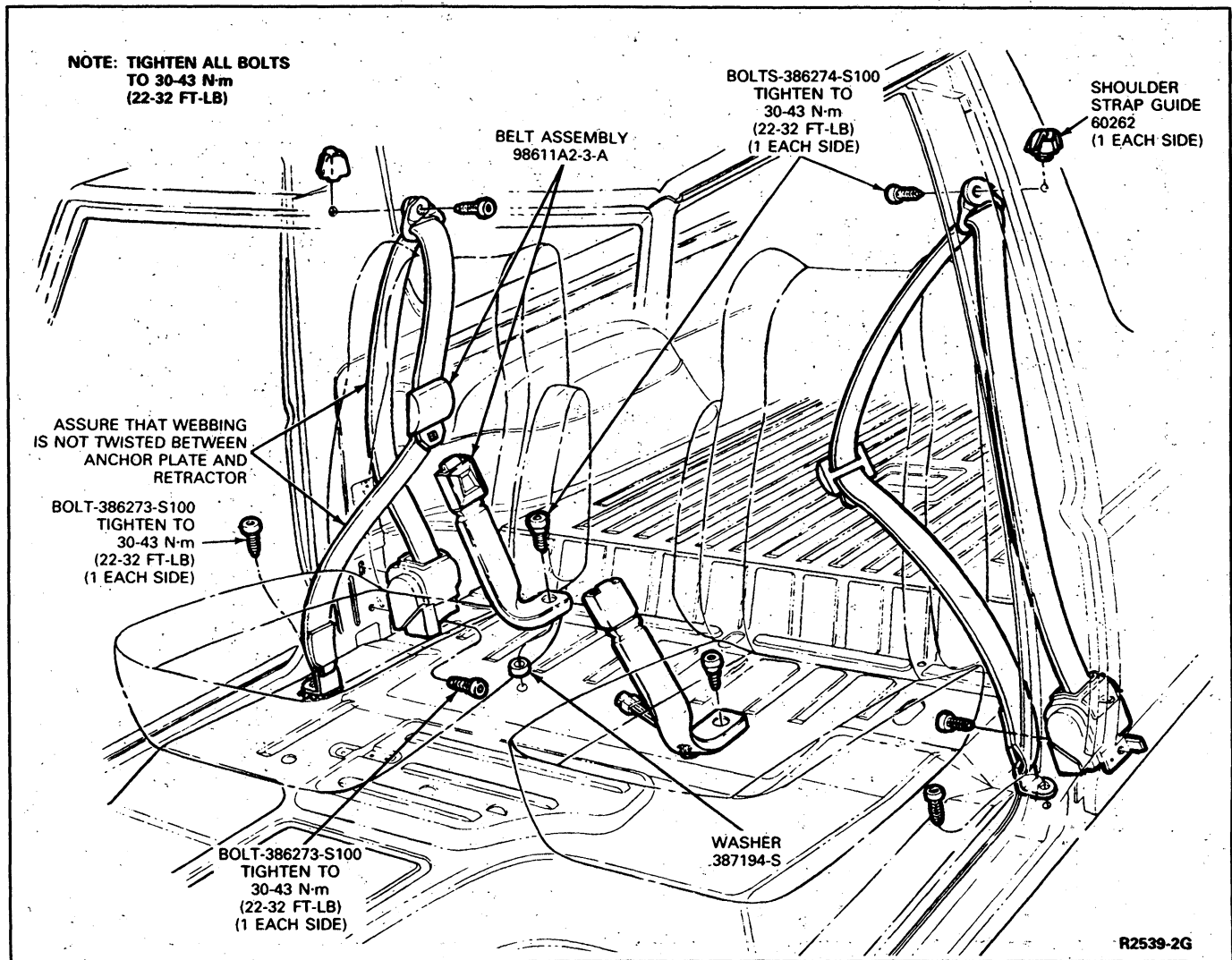


FIG. 1 Seat Belt Installation—Bronco Front Bucket Seat

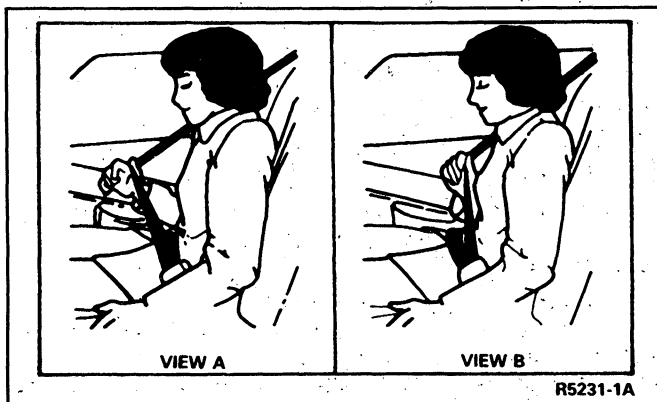


FIG. 2 Seat Belt Adjustment

### Continuous Loop System Description

The occupant restraint system for front outboard passengers is a continuous loop system (Figs. 1 through 5). The outboard combination lap and shoulder belt use a common sliding tongue. To secure the belts, the tongue is inserted into the inboard buckle.

On F-150—F-350, Bronco, the webbing for the lap belt is anchored near the inboard side of the sill **without**

a retractor. On E-150—E-350, it is attached to the seat pedestal.

The shoulder harness retractor is designed to let the webbing freely move in or out at all times, except during vehicle maximum deceleration, when it is automatically locked by a mechanically actuated inertia sensor.

On bench seat installations, the inboard belt with the buckle passes through the seat before being anchored to the floor, and directly to a fixed anchorage on the floor on bucket seat installations (except E-150—E-350). Attaching the tongue and buckle secures the occupant with both lower and upper restraints. This tongue and buckle attachment can be accomplished by a single continuous movement.

After entering the vehicle, adjust the front seat to obtain the best position for driving comfort and visibility. Then, use the following procedure for fastening belts:

Pull up on the shoulder portion of the belt to tighten the lap portion to a snug fit. Be sure the belt is as low on your hips as possible. If the shoulder belt is uncomfortably tight, a comfort regulator is provided in the shoulder belt retractor to reduce belt pressure against your chest. The shoulder belt can be adjusted much like a window shade to maintain a small amount

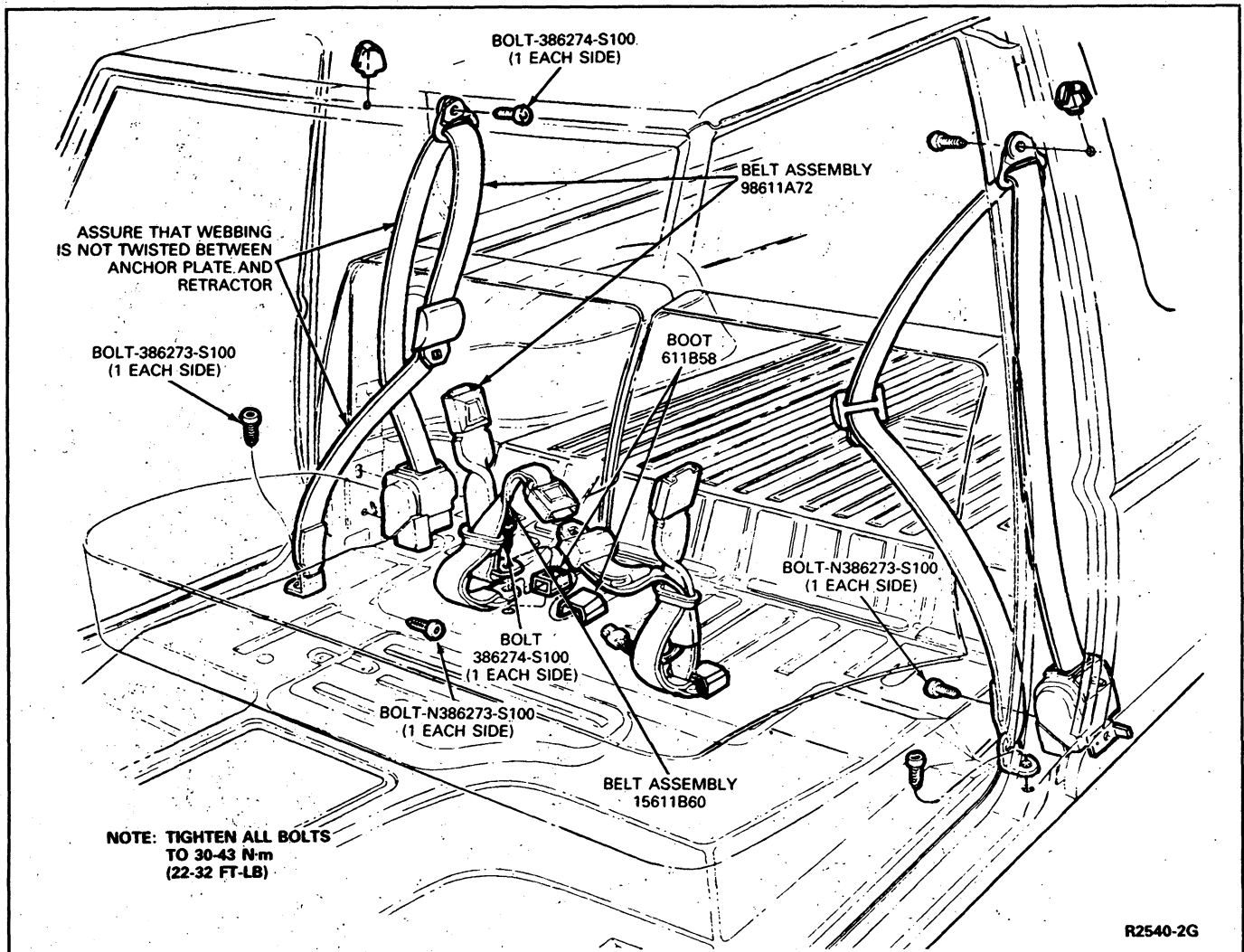


FIG. 3 Seat Belt Installation—Bronco Front Bench Seat

of slack in the belt. The adjacent door must be closed to use this comfort regulator feature.

#### Adjustment Procedure

To set the comfort regulator, the shoulder belt initially should be positioned snug against the chest. If the belt is not snug, the comfort regulator may already be engaged. Disengagement is accomplished by the following procedure:

1. Pull the shoulder belt outward 10-13 cm (4-5 inches), then release it and allow belt to fully retract. Repeat procedure if belt is not snug to the chest (Fig. 2, View A).
2. Now the belt tension may be adjusted by pulling down slightly on the shoulder belt and releasing. The least amount of slack needed to relieve tension, but not more than 25 mm (1.0 inch) should be pulled out when using the comfort regulator system (Fig. 2, View B).

If the desired setting is not achieved or excess slack develops as you change seat position, repeat the above procedure.

When the door is opened, the comfort regulator releases automatically, permitting the lap-shoulder belt to retract. After unbuckling the belt it is recommended

that you guide the tongue during retraction to prevent it from striking you or the vehicle.

#### Two-Point Lap Belt Operation—Non-Retractor

(All E-150—E-350 Rear Seats Except Captain's Chairs and Second Row Bench With Retractors)

To lengthen the belt, tip the tongue at a right angle to the belt, and pull the tongue until the ends can be joined over the lap.

To fasten the belt, insert the tongue into the open end of the buckle until a snap is heard. To shorten the belt, pull on the loose end of the webbing. **The belt should be snug across the hips, NEVER ACROSS THE WAIST.**

#### Two-Point Lap Belt Operation—Retractor

(F-150—F-350 Super Cab and Bronco Rear Seats and E-150—E-350 Second Row Captain's Chairs and Second Row Bench with Retractors)

The webbing for the lap belt extends from a retractor that automatically locks when the belt is worn (Figs. 6, 7, 8, 9 and 10). This lock prevents the belt from being pulled out further but allows the belt to retract and thus maintains a snug fit around the user for optimum safety.

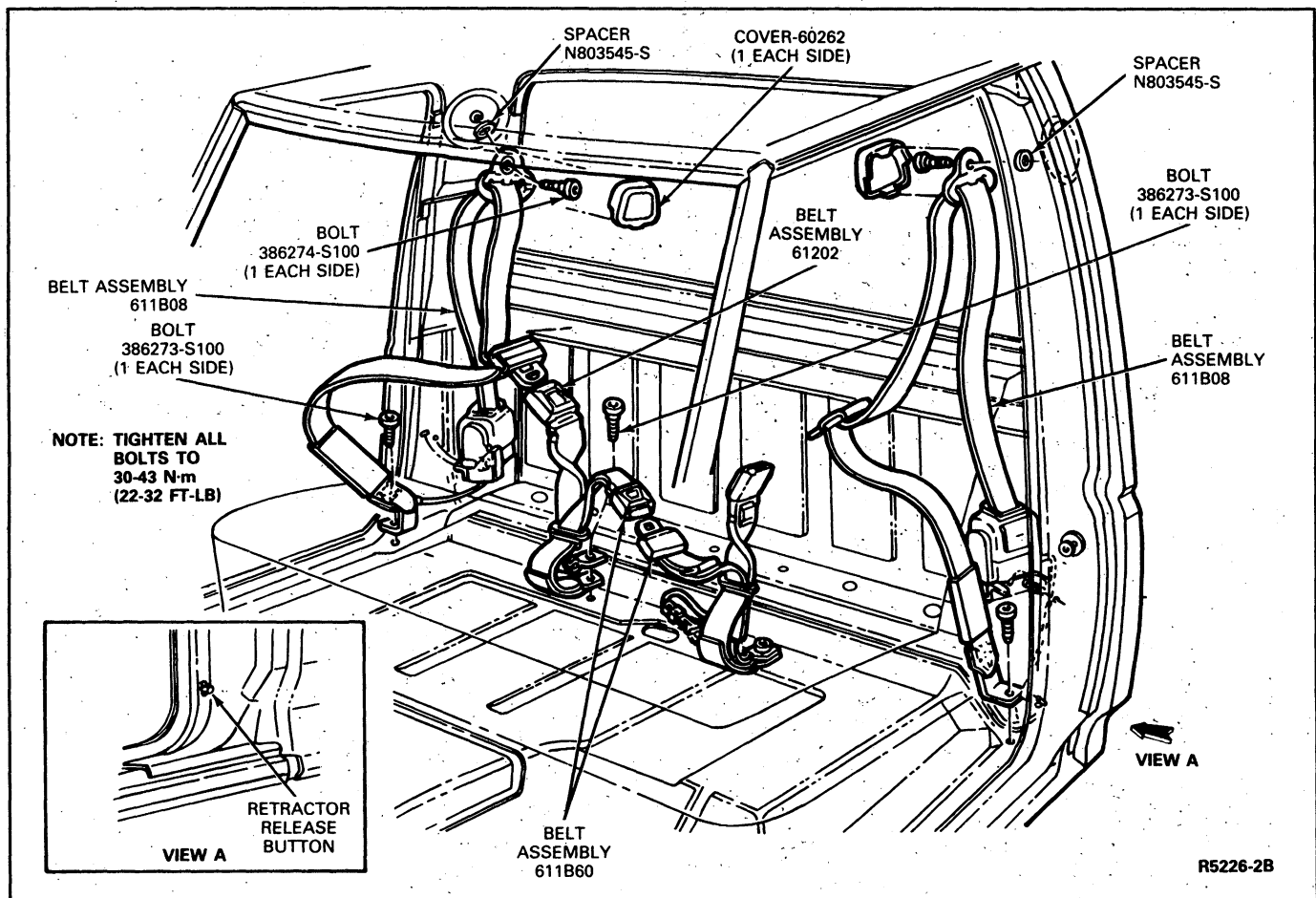


FIG. 4 Front Seat Belt Installation—F-150—F-350 Regular Cab Shown, F-350 Crew Cab Similar

### Center Lap Belts

The center seat belts do not have retractors (Figs. 3 and 4). To lengthen the belt, tip the tongue at a right angle to the belt, and pull the tongue until the ends can be joined over the lap.

To fasten the belt, insert the tongue into the open end of the buckle until a snap is heard. To shorten the belt, pull on the loose end of the webbing. **The belt should be snug across the hips, NEVER ACROSS THE WAIST.**

### Unfastening Seat Belts

Push the release button in the buckle and allow the front and rear outboard belts to retract to the fully stowed position.

### ADJUSTMENTS

#### Rear Belts

(Super Cab, Crew Cab and Bronco E-150—E-350 Captain's Chair, Second Row Bench Except 12-15-Passenger)

To fasten the rear belts, pull the belt out of the retractor with a steady motion and insert it into the buckle until a snap is heard and a latch is felt (Figs. 6, 7 and 8.) **Adjust the lap belt snugly across the hips, NEVER ACROSS THE WAIST, by allowing the slack to return to the retractor.**

### Seat Belt Maintenance

Seat belt assemblies are maintenance-free; however, they should be periodically inspected to ensure that they have not become damaged and that they remain in proper operating condition.

### Jammed Lap Belt Retractor Two-Point Systems

If the lap belt retractor is jammed by allowing the belt to retract while twisted, webbing can be freed with this procedure:

1. Use both hands to tighten the webbing on the spool by pulling on the belt.
2. Push the webbing into the retractor until the belt is completely retracted. Repeat Step 1 if necessary.
3. Pull the belt out of the retractor as far as it will go and inspect the webbing for foreign material or twisting. Remove the foreign matter or untwist the belt and let the webbing retract.
4. Sit in the seat, pull out the lap belt, and buckle up. Do this about five times to ensure the belt retractor operates properly.

### TESTING

#### Webbing Cannot be Pulled from Lap Belt Retractor

1. From the fully stowed position, pull webbing out of the lap belt retractor.

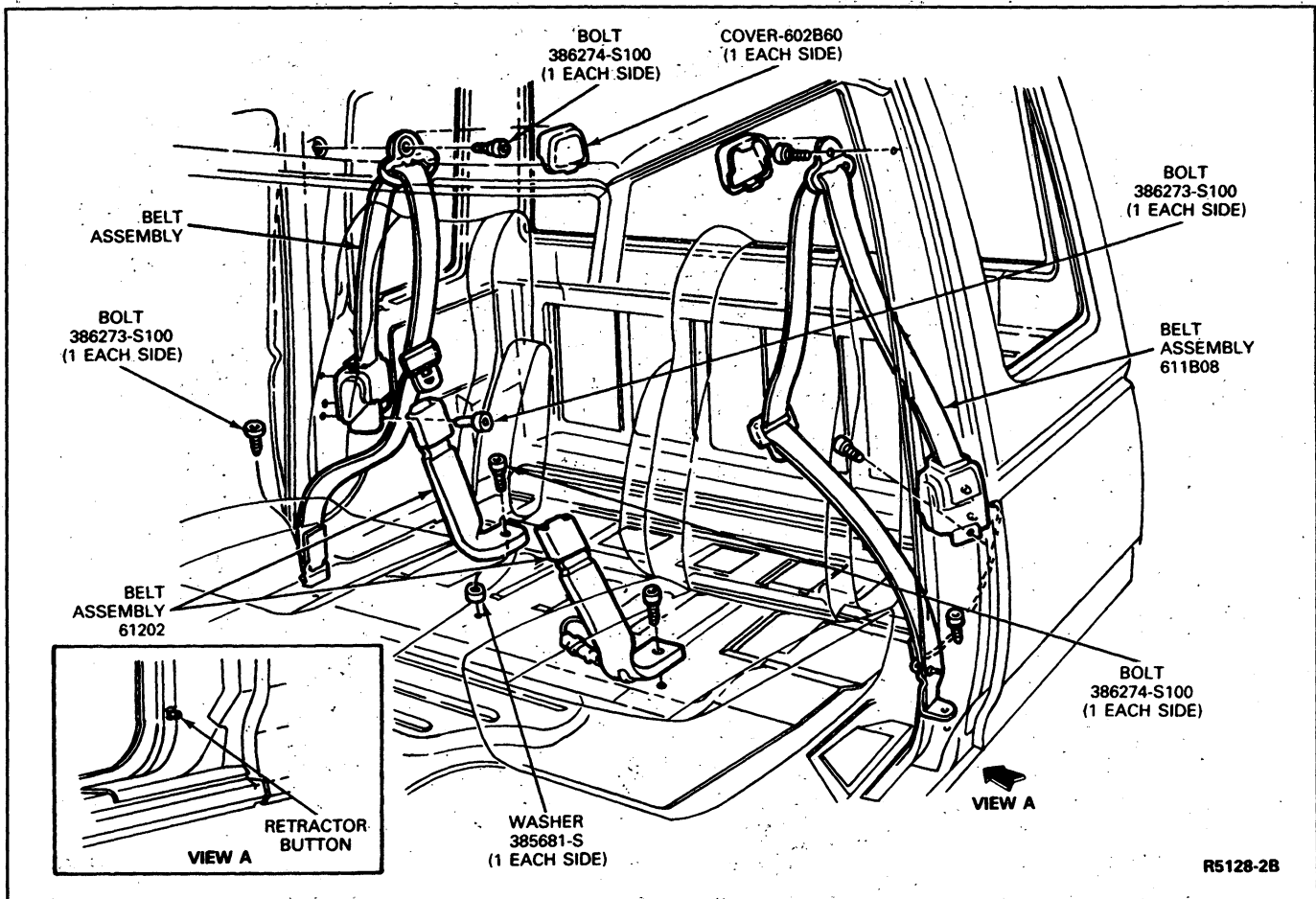


FIG. 5 Front Seat Belt Installation—F-Series Super Cab With Captain's Chair

2. If OK, withdraw lap belt webbing and buckle up while sitting in seat. Repeat five times to ensure proper operation. If not OK, replace the seat belt assembly.

#### Lap Belt Retractor Does Not Lock

1. Withdraw a minimum of 457.2mm (18 inches) of webbing from lap belt retractor and check for lock-up. (Retractor must lock up after 457.2mm (18 inches) of webbing withdrawal.) Return 50.8mm (2 inches) into retractor and pull out.
2. If not OK, replace the seat belt assembly. Withdraw lap belt webbing and buckle up while sitting in seat. Repeat five times, to ensure proper operation. If not OK, replace the seat belt assembly.

## REMOVAL AND INSTALLATION

### Seat Belts

#### Removal and Installation

Use Seat Belt Bolt Bit T77L-2100-A or equivalent to remove or install all seat belt assembly anchor bolts. Upon installation, tighten the anchor bolts to 30-43 N·m (22-32 ft-lb).

#### Bronco—Front Bucket Seats

#### Removal and Installation

Remove the shoulder belt retractor cover. Remove the shoulder belt retractor anchor bolt and the floor

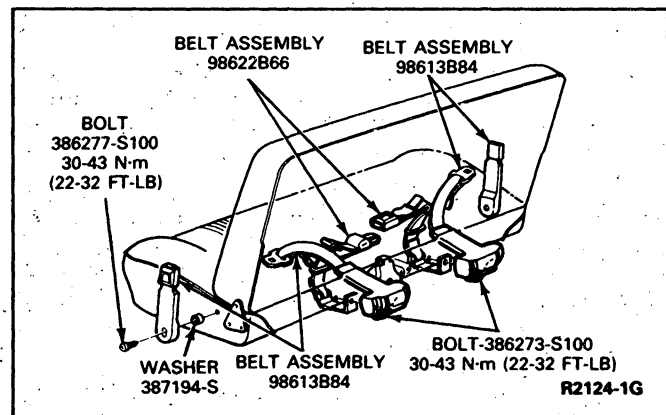


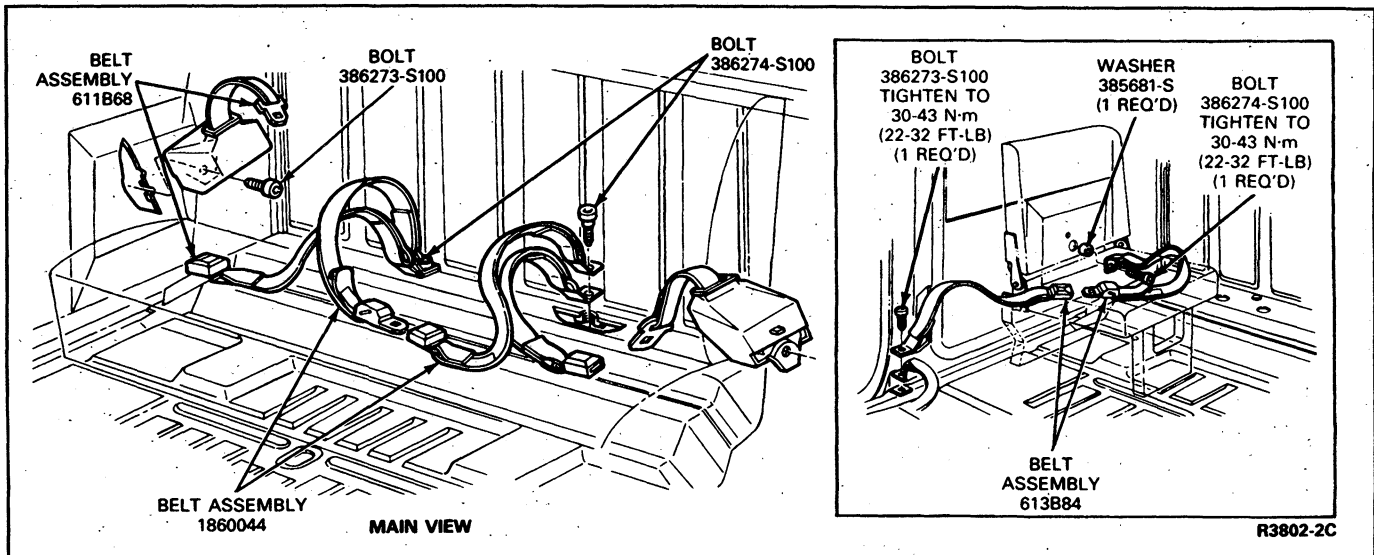
FIG. 6 Seat Belt Installation—Bronco Rear Seat

anchor bolt. Remove affected seat belt assembly from the vehicle (Fig. 1).

The buckle end of the front seat belt can be removed by removing the seat belt anchor bolt from the floor. Driver's buckle contains an electrical switch, which must be disconnected before removing the anchor bolt.

On rear seat positions, remove any affected seat belt assemblies by removing the seat belt anchor bolts from the seat frame (Fig. 6).

Reverse the above procedure for installing the replacement seat belt assemblies in the vehicle as shown in Fig. 1. Check for sealer around each removed



**FIG. 7 Rear Seat Belt Installation—F-Series Super Cab**

floor anchor bolt holes. Add Ford Caulking Cord D6AZ-19560-A or equivalent sealer, if necessary.

#### **Bronco-Front Bench Seat (Fig. 3)**

##### **Removal and Installation**

Remove the shoulder belt retractor cover and lift from floor anchor. Remove the shoulder belt retractor anchor bolt and the floor anchor bolt. Remove affected seat belt assembly from the vehicle (Fig. 3).

Remove the buckle end of the front bench seat belt by removing the anchor bolt at the floor. The driver's side buckle contains an electrical connector which must be disconnected before removing the anchor bolt.

Install by connecting the electrical connector (driver's side only) and securing with the anchor bolt. Install cover.

Reverse the above procedure for installing the replacement seat belt assemblies in the vehicle as shown in Fig. 3. Check for sealer around each removed floor anchor bolt hole. Add Ford Caulking Cord D6AZ-19560-A or equivalent sealer, if necessary.

#### **F-150—F-350 Regular Cab**

##### **Removal and Installation**

On front seat outboard positions only: Remove the shoulder belt retractor cover. Remove the shoulder belt retractor anchor bolt and the lap belt bolt. Remove affected seat belt assembly from the vehicle.

The buckle end of the front seat belt and the center seating position belts can be removed by removing the seat belt anchor bolt from the floor. Driver's buckle contains an electrical switch. Disconnect switch before removing the anchor bolt.

Reverse the above procedure for installing the replacement seat belt assemblies in the vehicle as shown in Fig. 5. Check for sealer around each removed floor anchor bolt holes. Add Ford Caulking Cord D6AZ-19560-A or equivalent sealer, if necessary.

#### **E-150—E-350 and F-350 Crew Cab—(Figs. 4 and 8)**

##### **Removal and Installation**

Remove any affected seat belt assemblies by removing the seat belt anchor bolts from under or on the outboard side of the seat. **NOTE:** Remove the seat assembly for access to the LH seat belt outboard attaching bolt.

**Fourth Seat and Seat/Bed—**Remove any affected seat belt assemblies by removing the seat belt attaching bolts from the rear floor.

Note location of steel and rubber washers so they can be correctly replaced.

Reverse the above procedure for installing the replacement seat belt assemblies in the vehicle, and position as shown in Figs. 4 and 8. Check for sealer around each removed floor anchor bolt holes. Add Ford Caulking Cord D6AZ-19560-A or equivalent sealer, if necessary.

#### **F-150—F-350 Super Cab**

##### **Removal and Installation**

(Refer to Fig. 7)

On front seat outboard positions only: Lift the cover from the D-ring attachment and remove the rear seat area trim panel from over the shoulder belt retractor. Remove the shoulder belt retractor anchor bolt, the D-ring attaching bolt. Remove the affected seat belt assembly from the vehicle.

The buckle end of the front seat belt can be removed by lifting the cover and removing the seat belt anchor bolt. Driver's buckle contains an electrical switch. Disconnect before removing the anchor bolt.

Rear seat and front center seating positions: Remove any affected seat belt assemblies by removing the seat belt anchor bolts from the rear floor.

Reverse the above procedure for installing the replacement seat belt assemblies in the vehicle as shown in Figs. 5 and 7. Check for sealer around each removed floor anchor bolt holes and add Ford Caulking Cord D6AZ-19560-A or equivalent sealer, if necessary.

## MAJOR REPAIR OPERATIONS

### Seat and Shoulder Belts

The seat belts and shoulder belts are factory-installed in their proper locations. If the belts are removed for any reason, they should be installed as shown in Figs. 1 through 10. Apply Ford Caulking Cord D6AZ-19560-A or equivalent sealer around all seat belt anchor bolt holes in the floorpan. Tighten the anchor bolts to 30-43 N·m (22-32 ft-lb).

### Seat Belt with No Anchor Plate Thread Damage

1. Remove the damaged bolt for the anchor reinforcement and discard.
2. Install a new bolt with the same part number as indicated under Specifications. Tighten to 30-43 N·m (22-32 ft-lb).

### Seat and Shoulder Harness Belt with Damaged Anchor Plate Threads

1. Remove the broken or stripped bolt and discard.
2. Drill out the internal threads in the seat belt anchor plate with a 27/64-inch drill.
3. Re-thread the anchor plate with a 1/2-13 tap (seat belt).
4. Blow out the chips.
5. Install the attachment parts in the sequence shown. Refer to applicable illustration (Figs. 1 through 10). Tighten the replacement bolt to 30-43 N·m (22-32 ft-lb). Original parts are to be replaced with the repair parts indicated in the seat belt parts replacement guides. Refer to Specifications. Unless specified in the guides, use original parts.
6. When repairing a multiple belt and attachment, install nut 382599-S100 to the bolt in the tunnel area from the underside of the floorpan. Tighten to 30-43 N·m (22-32 ft-lb).

### Seat Belt Procedure After an Accident

All seat belt assemblies must be replaced after a collision, provided either:

1. The seat belt was in use at the time of the accident, or
2. The seat belt was damaged by the accident (bent retractor, torn webbing, etc.), or
3. The seat belt attaching area(s) was damaged by the accident.

Before installing the new seat belt assembly, the seat belt attaching areas must be inspected for damage and distortion. If the attaching points are damaged and distorted, the sheet metal must be reworked back to its original shape and structural integrity.

Install the new seat belt(s). Then perform Functional Test Procedure as outlined.

### Damaged Anchor Plate Threads Functional Test Procedure

Determine the type(s) of seat belt assembly(s) that have been replaced. Then, functionally test the new seat belt assembly using the appropriate procedure.

### Lap Belt Retractor Test—(Two-Point System)

Grasp the new seat belt tongue and pull the webbing out of the retractor until the manufacturer's label is exposed. Return approximately 127mm (5 inches) of webbing into the retractor and pull. If the retractor locks, the belt assembly is functioning properly. If the retractor does not lock or the webbing cannot be pulled from the retractor far enough to expose the manufacturer's identification label, rework the sheet metal surface in the seat belt retractor attaching area until the retractor will function properly.

NOTE: If the retractor of a new seat belt assembly has been bolted into a damaged or distorted mounting area, the new retractor could be warped and may not function. If this is the case, reshape the sheet metal and install another new complete seat belt assembly.

### Continuous Loop Shoulder/Lap Belt Test—(System with Movable Tongue and One Retractor)

1. Driver will buckle up and proceed to a safe test area. If the RH passenger seat belt must be tested, a passenger should be buckled into the RH seat. (The passenger belt may be tested utilizing a driver only, providing the driver has the ability to grasp the RH shoulder belt and extend it approximately 660.4mm (26 inches) with no compromise to safe driving.) This method applies to the 8.05 km/h (5 mph) test only.

NOTE: The RH shoulder belt is not extended fully to preclude the possibility of a false feeling (full extension vs. lock-up).

2. After reaching a safe area to perform sudden stops, the driver will attain a speed of approximately 8 km/h (5 mph). The driver should inform the passenger, if applicable, that he is preparing to make a severe brake application. At this time, both driver and rider should grasp their respective shoulder harness and prepare to lean slightly forward at the moment the brake application is made.
3. The driver will make a maximum brake application (approximately  $9.7\text{m/sec}^2$  ( $32\text{ft/sec}^2$ )) without tire skid. (The maximum brake application should be on dry concrete or equivalent hard road surface. Never on a wet or gravel road.) The driver and passenger should lean forward slightly into the shoulder harness. At this instant, the belts should lock up without webbing payout.

**WARNING: THE DRIVER AND PASSENGER SHOULD BE PREPARED TO BRACE THEMSELVES IN THE EVENT THE SEAT BELT RETRACTOR DOES NOT LOCK.**

4. If there is a lock-up of both shoulder straps, the seat belt assemblies are functioning properly. Should either or both retractors fail to lock up at the 8.05 km/h (5 mph) speed, the test should be repeated at a constant 24.14 km/h (15 mph). (This test must be performed with a RH passenger if the RH belt is to be tested.)
5. If either or both shoulder belts do not lock up at the 24.14 km/h (15 mph) test, the vehicle is to be returned for repair of the malfunctioning seat belts. Remove the retractor and rework the sheet metal in the retractor's mounting surface. Install the

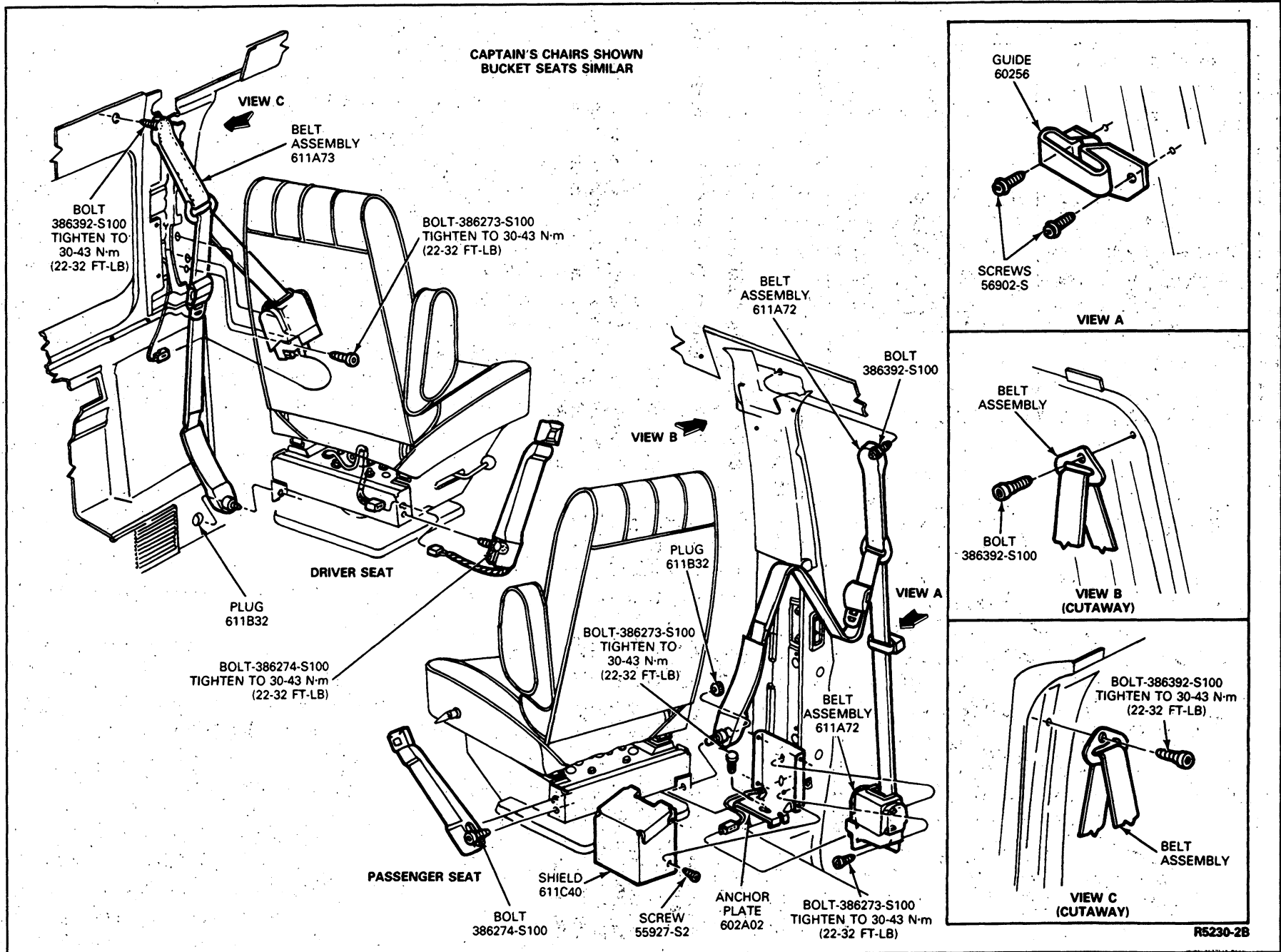


FIG. 8 Front Seat Belt Installation—E-150—E-350 Captain's Chairs

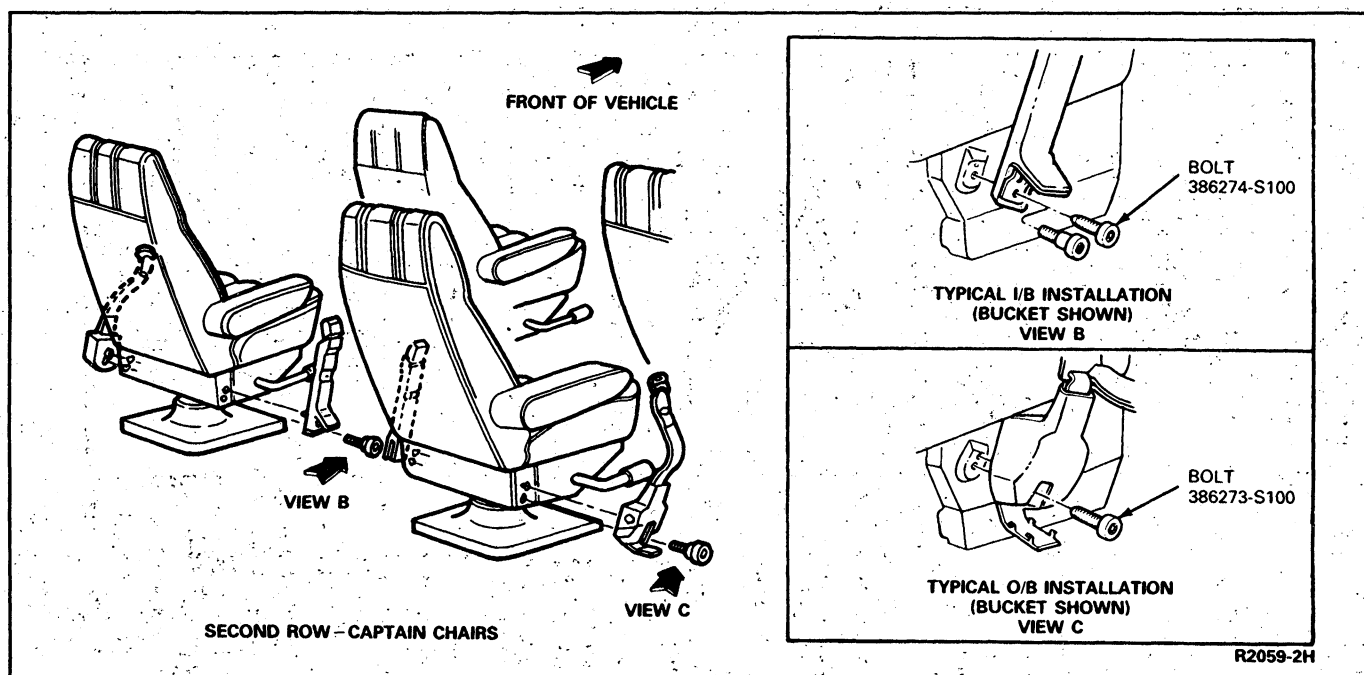


FIG. 9 Rear Seat Belt Installation—E-150—E-350—Captain's Chair

retractor assembly and test the seat belt assembly(s) as previously stated.

**WARNING: IF THE RETRACTOR OF A NEW SEAT BELT ASSEMBLY HAS BEEN BOLTED INTO A DAMAGED OR DISTORTED MOUNTING AREA, THE NEW RETRACTOR COULD BE WARPED AND MAY NOT FUNCTION. IF THIS IS THE CASE, RESHAPE THE SHEET METAL AND INSTALL ANOTHER NEW COMPLETE SEAT BELT ASSEMBLY.**

## CLEANING PROCEDURE

Refer to Section 45-01 Interior Trim, General Service.

## DIAGNOSIS

The following Diagnosis Guides provide information to isolate malfunctions in the seat belt warning system used on three-point and continuous loop seat belt systems.



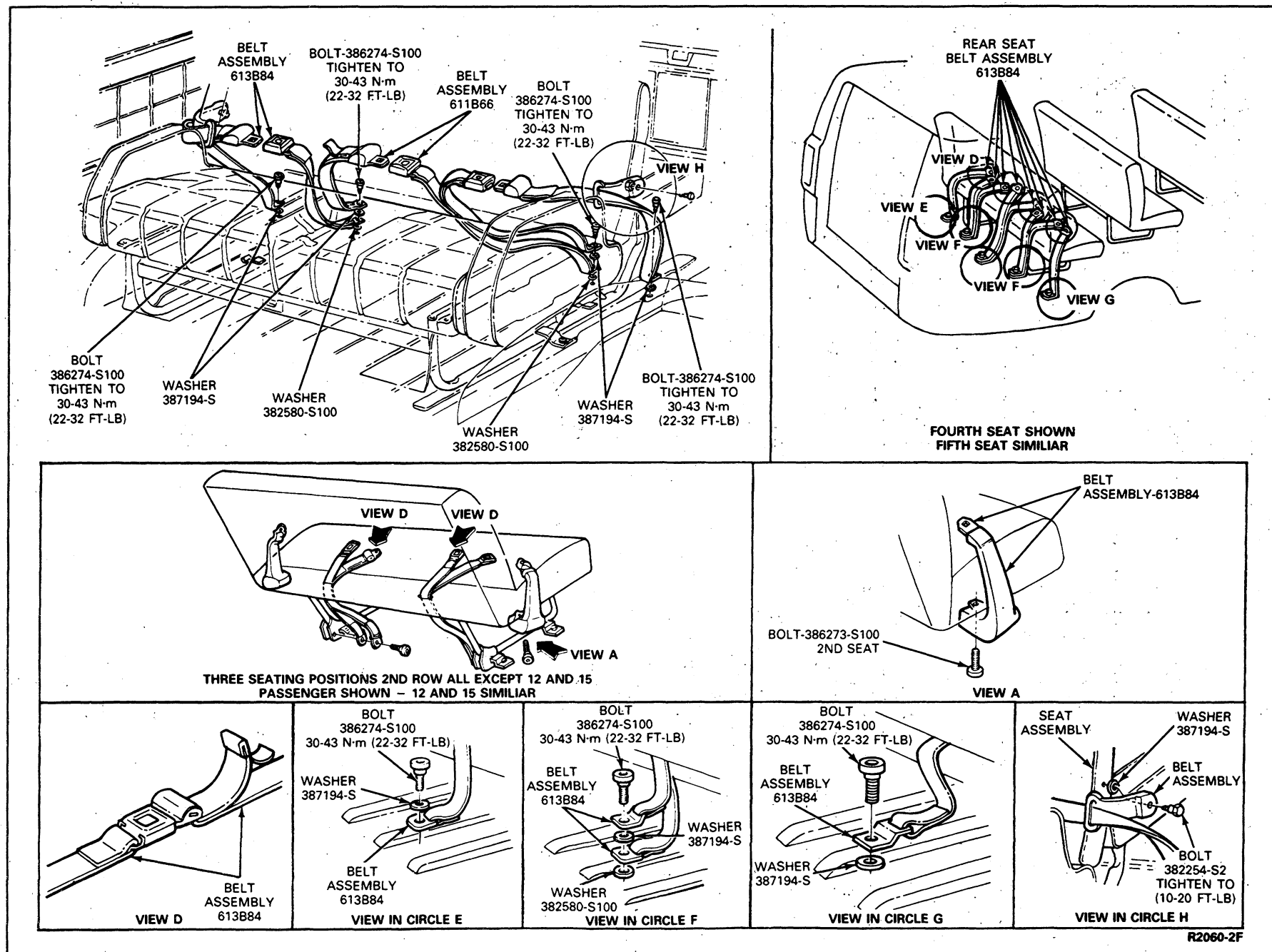


FIG. 10 Second, Third, Fourth and Fifth Row Seat Belt Installation—E-150—E-350

## SEAT BELT WARNING SYSTEM

TEST STEP		RESULT	ACTION TO TAKE
1.0	DURING SYSTEM CHECK — SEAT BELT BUZZER DOES NOT OPERATE (SEAT BELT LAMP OPERATING PROPERLY)		
1.1	CHECK CIRCUIT		
	<ul style="list-style-type: none"> <li>Remove connector from thermal timer buzzer.</li> <li>Using a continuity lamp to verify vehicle ground with driver's tongue and buckle disengaged.</li> </ul>	Circuit not okay	TRACE circuit to driver's buckle switch and REPAIR as necessary.  CHECK for shorted or trapped wires.

CK5316-2D

## SEAT BELT WARNING SYSTEM

TEST STEP		RESULT	ACTION TO TAKE
2.0	DURING SYSTEM CHECK — SEAT BELT WARNING LAMP DOES NOT GO OUT SHORTLY AFTER ENGINE IS STARTED (BUZZER/CHIME OPERATES PROPERLY)		
2.1	CHECK CIRCUIT		
	<ul style="list-style-type: none"> <li>Remove connector from thermal timer buzzer/chime. Lamp should go out.</li> </ul>	Lamp goes out  Lamp does not go out	GO to 2.2.  TRACE circuit from the thermal timer buzzer/chime connector to the bulb. REPAIR as necessary.
2.2	REPLACE THERMAL TIMER BUZZER		
	<ul style="list-style-type: none"> <li>Replace thermal timer buzzer/chime with known good part. Lamp and buzzer/chime should operate properly.</li> </ul>	Lamp and buzzer/chime operate properly  Lamp and buzzer/chime not operational	System functional.  RECHECK proper circuit input to thermal timer buzzer/chime. Inputs are ignition, ground, lamp and driver's buckle switch. Check and repair any crossed wires.

CK5317-2E

## SEAT BELT WARNING SYSTEM

TEST STEP		RESULT	ACTION TO TAKE
3.0	DURING SYSTEM CHECK — SEAT BELT AND/OR BUZZER/CHIME DO NOT OPERATE		
3.1	CHECK FUSE		
	<ul style="list-style-type: none"> <li>Check warning lamp fuse.</li> </ul>	Fuse bad Fuse is good	REPLACE fuse. If fuse blows again CHECK for short circuit. GO to 3.2.
3.2	CHECK IGNITION FEED CIRCUIT, AND SEAT BELT LAMP CIRCUIT		
	<ul style="list-style-type: none"> <li>Locate and remove connector for thermal timer buzzer/chime.</li> <li>Turn ignition key to "RUN" position.</li> <li>Using a jumper wire, jump between ignition feed terminal circuit No. 640 red/yellow hash on F-150 — F-350 and Bronco, circuit No. 584 green/blue stripe on E-150 — E-350 and seat belt lamp circuit No. 450 dark green/light green stripe F-150 — F-350 and Bronco, circuit No. 670 pink on E-150 — E-350, seat belt lamp should light.</li> </ul>	Seat belt lamp lights Seat belt lamp does not light	REPLACE thermal timer buzzer with known good unit. If lamp and buzzer operate properly, system is functional. GO to 3.3.
3.3	CHECK BULB		
	<ul style="list-style-type: none"> <li>Remove bulb and check continuity of bulb.</li> </ul>	Bulb not good Bulb is good	REPLACE bulb. GO to 3.4.
3.4	CHECK CONTINUITY OF BULB WIRE		
	<ul style="list-style-type: none"> <li>Check continuity of wire from thermal timer to bulb.</li> </ul>	Wiring okay Wiring not okay	GO to 3.5. REPAIR open circuit in wire between timer and bulb.
3.5	CHECK GROUND		
	<ul style="list-style-type: none"> <li>Check for vehicle ground at bulb.</li> </ul>	Vehicle ground okay Vehicle ground not okay	REPLACE thermal timer buzzer/chime with known good unit. RECHECK system. REPAIR vehicle at bulb. TRACE circuit back to junction and REPAIR.

CK5318-2C

## SPECIFICATIONS

## PARTS REPLACEMENT CHART — SEAT AND SHOULDER BELT WITH DAMAGED WELD NUT ANCHOR PLATE THREADS

Original Parts — Seat Belt			Replacement Parts — Seat Belt		
Part No.	① Code Letter	Part Name	Part No.	① Code Letter	Part Name
386273-S100	IA	Bolt — 7/16-20 x 1.38 Pan Head Tapping	383531-S36	X	Bolt — 1/2-13 x 1.38 Pan Locking
386274-S100	IB	Bolt — 7/16-20 x 1.75 Pan Head Tapping (.50 Shoulder)	383753-S36	Y	Bolt — 1/2-13 x 1.75 Pan Locking (.50 Shoulder)
382629-S100	—	Washer — .463/.443 I.D. Plate (1.80 Dia. .190 Thick)	382552-S100	—	Washer — 1/2 Flat (1.30 Dia. .190 Thick)
382583-S100	—	Washer — 1/2 Serrated (.18 Thick)	382533-S100	—	Washer — 1/2 Flat (.25 Thick)
386272-S100	IF	Bolt — 7/16-20 x .88 Pan Head Tapping	383437-S36	W	Bolt — 1/2 x 13 Pan Locking
386276-S100	IL	Bolt — 7/16-20 x 1.75 Pan Shoulder Tapping (.75 Shoulder)	383754-S36	Z	Bolt — 1/2-13 x 2.25 Pan Locking (.88 Shoulder)
386277-S100	IK	Bolt — 7/16-20 x 1.38 Pan Shoulder Tapping (.50 Shoulder)	385709-S	T	Bolt — 1/2-13 x 1.38 Pan Head Shoulder Locking
382580-S100	—	Washer — 7/16			
386392-S100	IG	Bolt — Pan Head Tapping (7/16-20 x 2.15)	383754-S36	Z	Bolt — 1/2-13 x 2.25 Pan Locking (.88 Shoulder)
384966-S100	V	Bolt — 7/16-20 x 1.75 Pan Head Tapping			

① Identification letter on top of bolt head or face of spacer.

NOTE: Bolt Torque Must be Maintained at 30-43 N·m (22-32 ft-lbs)

CR3104-2B

## SPECIAL SERVICE TOOLS

Number	Description
T77L-2100-A	Seat Belt Bolt Bit

CR2388-1C

# SECTION 41-60 Seat Trim

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		REMOVAL AND INSTALLATION (Cont'd)	
Seat Trim .....	41-60-1	Seat Cushion and Back Cover—Bucket Seat (Cont'd)	
REMOVAL AND INSTALLATION		Bronco, F-Series and E-150—E-350 .....	41-60-1
Seat Back Cover—Bench Seat .....	41-60-7	Seat Cushion Cover—Bench Seat .....	41-60-1
Bronco, F-150—F-350 and E-150—		Bronco, F-150—F-350 and E-150—	
E-350 .....	41-60-7	E-350 .....	41-60-1
Seat Cushion and Back Cover—Bucket		VEHICLE APPLICATION .....	41-60-1
Seat .....	41-60-1		

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350, F-Super Cab and Bronco.

## DESCRIPTION

### Seat Trim

The following seat trim removal and installation procedures generally apply to all truck lines. If some of the steps do not apply to the particular vehicle being serviced, proceed to the next step and review the appropriate illustration shown.

Unless otherwise noted, the illustrations shown in this Section are typical of all bucket and bench seat assemblies. Refer to Figs. 1 through 16.

Seat trim replacement requires removal and installation of seat components such as seat assemblies, track assemblies and seat belts. Refer to the applicable Section in Group 41 for these procedures.

## REMOVAL AND INSTALLATION

NOTE: Repairs to seat cushions or seat backs are performed out of the vehicle and are usually for replacement of torn, worn or burned seat covers. In a few instances, the pads may be damaged and require replacement.

When installing a new seat or back cover assembly, refer to Figs. 1 through 16 for the location of listing wires, hog rings, anti-squeak pads, and seat pad stack-up.

### Seat Cushion and Back Cover—Bucket Seat

#### Removal and Installation

#### Bronco, F-Series and E-150—E-350

1. Remove the seat belt retainer loop, if so equipped (one screw). Remove the seat and track assembly if the cushion cover is to be replaced. Refer to the appropriate Section in Group 41.
2. Remove the seat tracks from the seat.

3. Remove the seat back assembly and the seat cushion stops.
4. Remove the hog rings and/or "J" retainers, retaining the seat cushion cover to the frame. Remove cover.
5. Remove the hog rings and/or "J" retainers, retaining the seat back cover to the frame. Remove cover.
6. Transfer the bolster wires to the cover listings.
7. Position the seat cushion cover to the seat. Install hog rings or "J" retainers as shown. Install the seat cushion stops.
8. Position the seat back assembly. Install hog rings or "J" retainers.
9. Install the seat back to the seat cushion assembly.
10. Install the seat tracks to the seat cushion and tighten to specifications. Refer to Sections 41-01, Front Seats; 41-14, Conventional Rear Seats and 41-20, Folding Rear Seats.
11. Install the seat assembly into the vehicle. Tighten to specifications. Refer to Sections 41-01, Front Seats; 41-14 Conventional Rear Seats and 41-20, Folding Rear Seats. Install the seat belt retainer loop, if so equipped (one screw).

### Seat Cushion Cover—Bench Seat

#### Bronco, F-150—F-350 and E-150—E-350

1. Remove the seat and track assembly from the vehicle. Refer to Sections 41-01, Front Seats; 41-14, Conventional Rear Seats and 41-20, Folding Rear Seats.
2. Remove the seat back assembly from the seat cushion (Figs. 7, 8, 10, 11, 13, 14, 15 and 16).
3. Cut the hog rings retaining the cushion cover to the frame assembly. Remove cover.
4. If the padding is being replaced, cut the hog rings attaching the padding to the spring assembly and remove the padding.

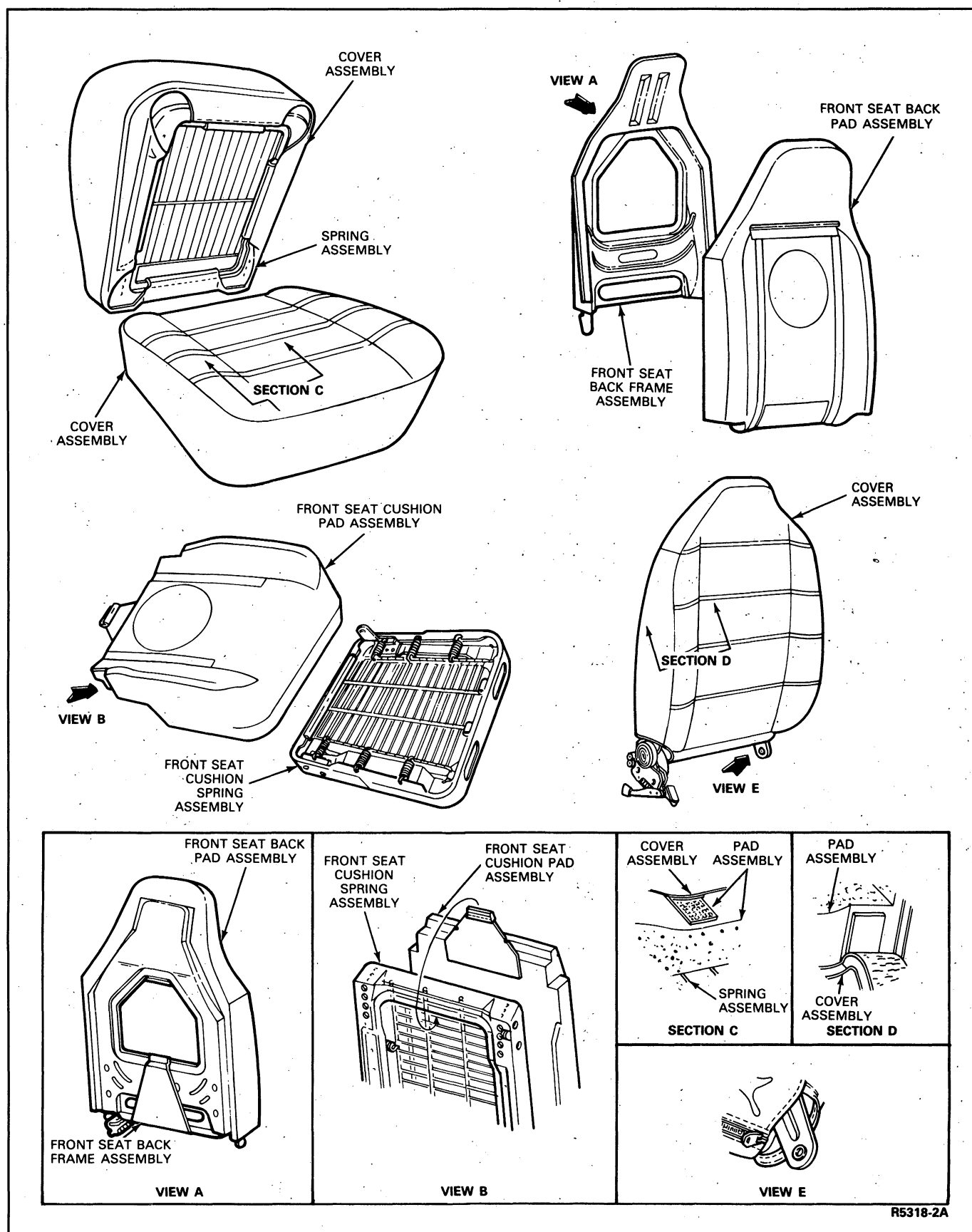
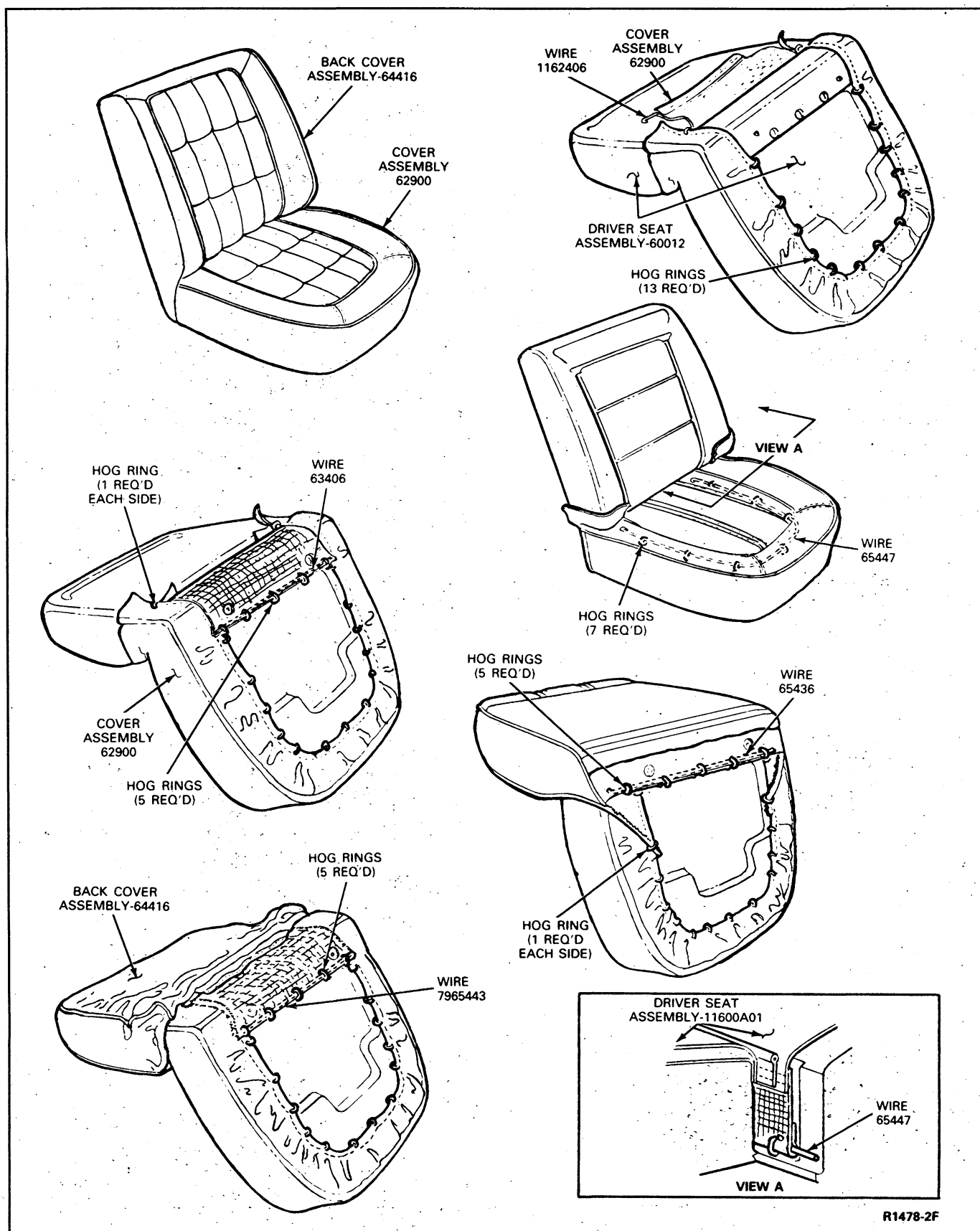


FIG. 1 Front Seat Cushion and Back Cover Installation Bronco-Bucket Seat



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FIG. 2 Front Seat Assemblies—E-150—E-350

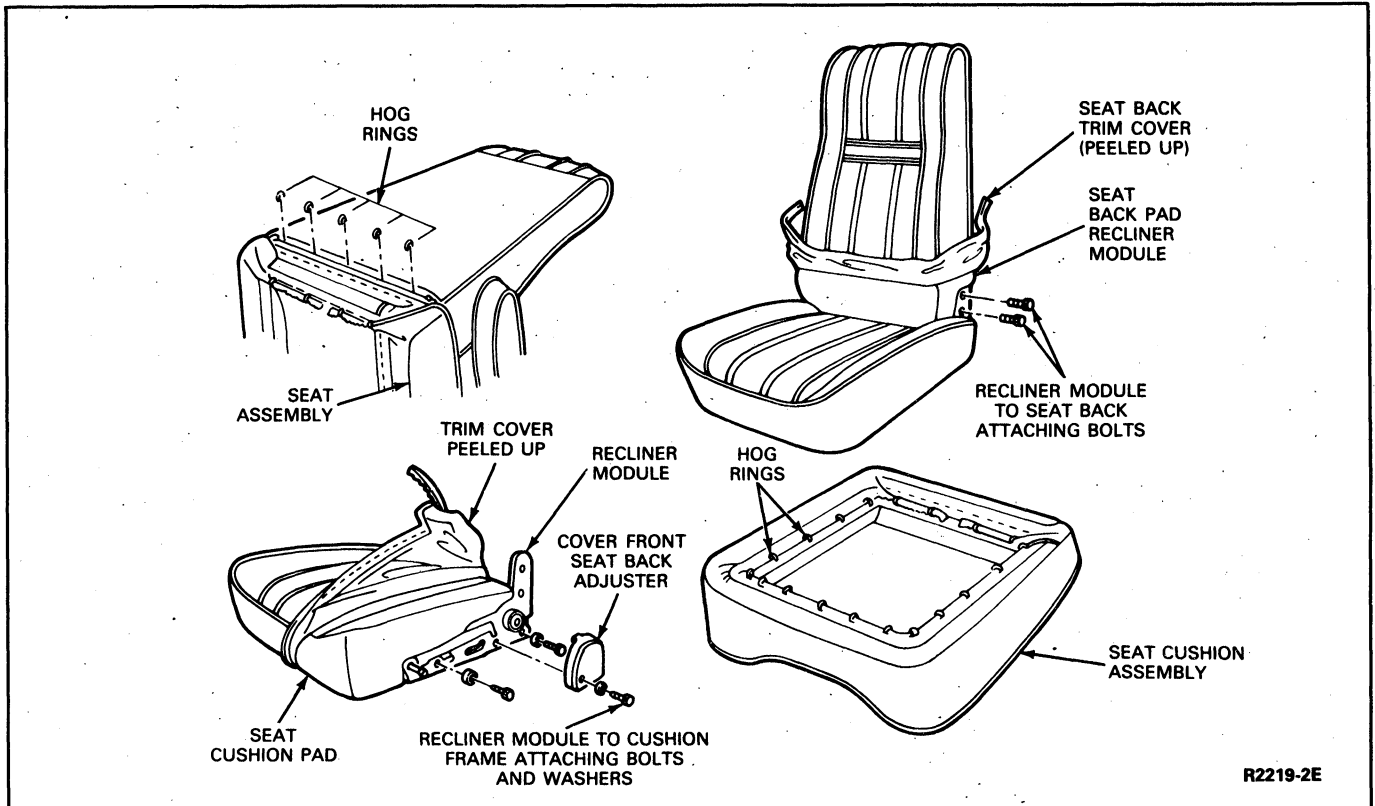


FIG. 3 Captains Chair—Reclining Seat Back/Stationary Supports, Pad and Cover—E-150—E-350

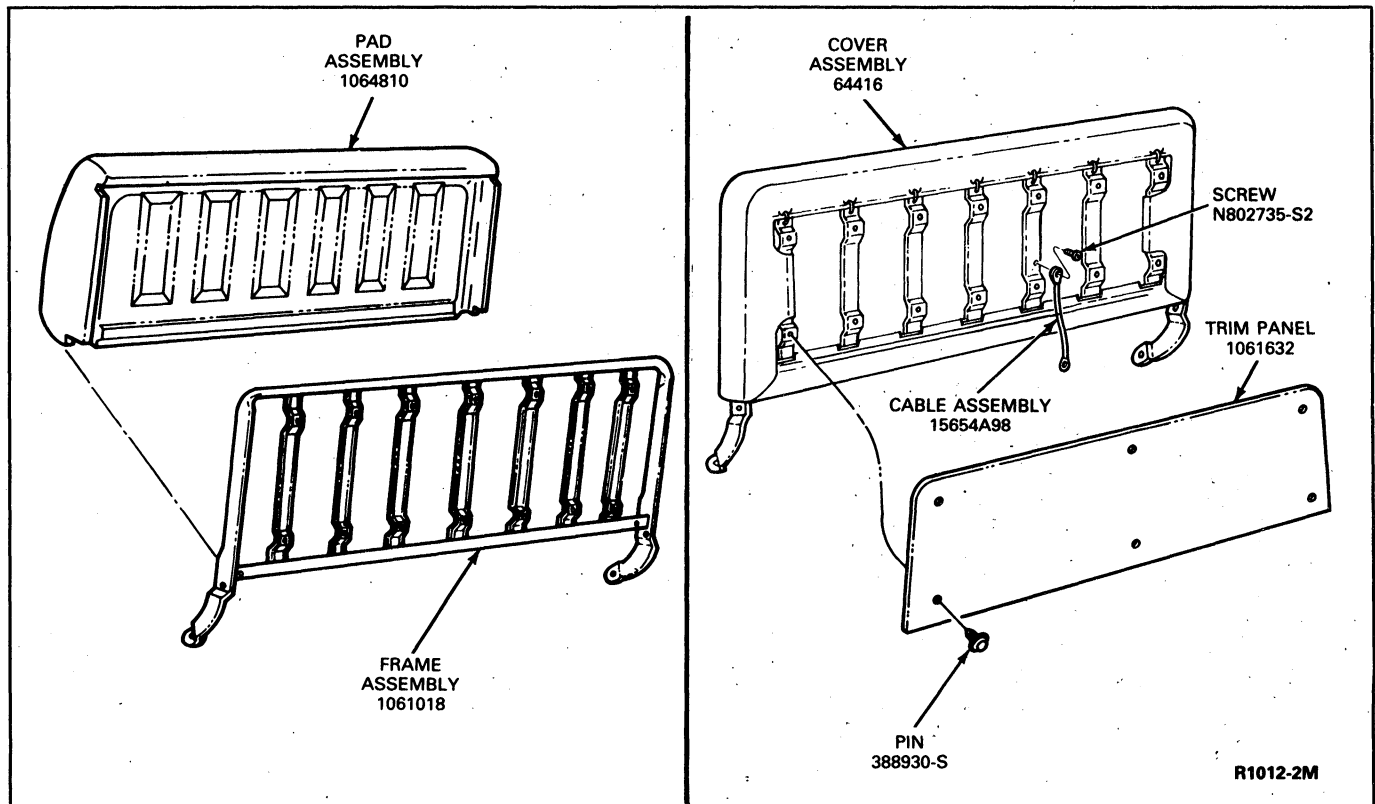


FIG. 4 Seat Back Cover Installation—F-150—F-350 and F-Super Duty



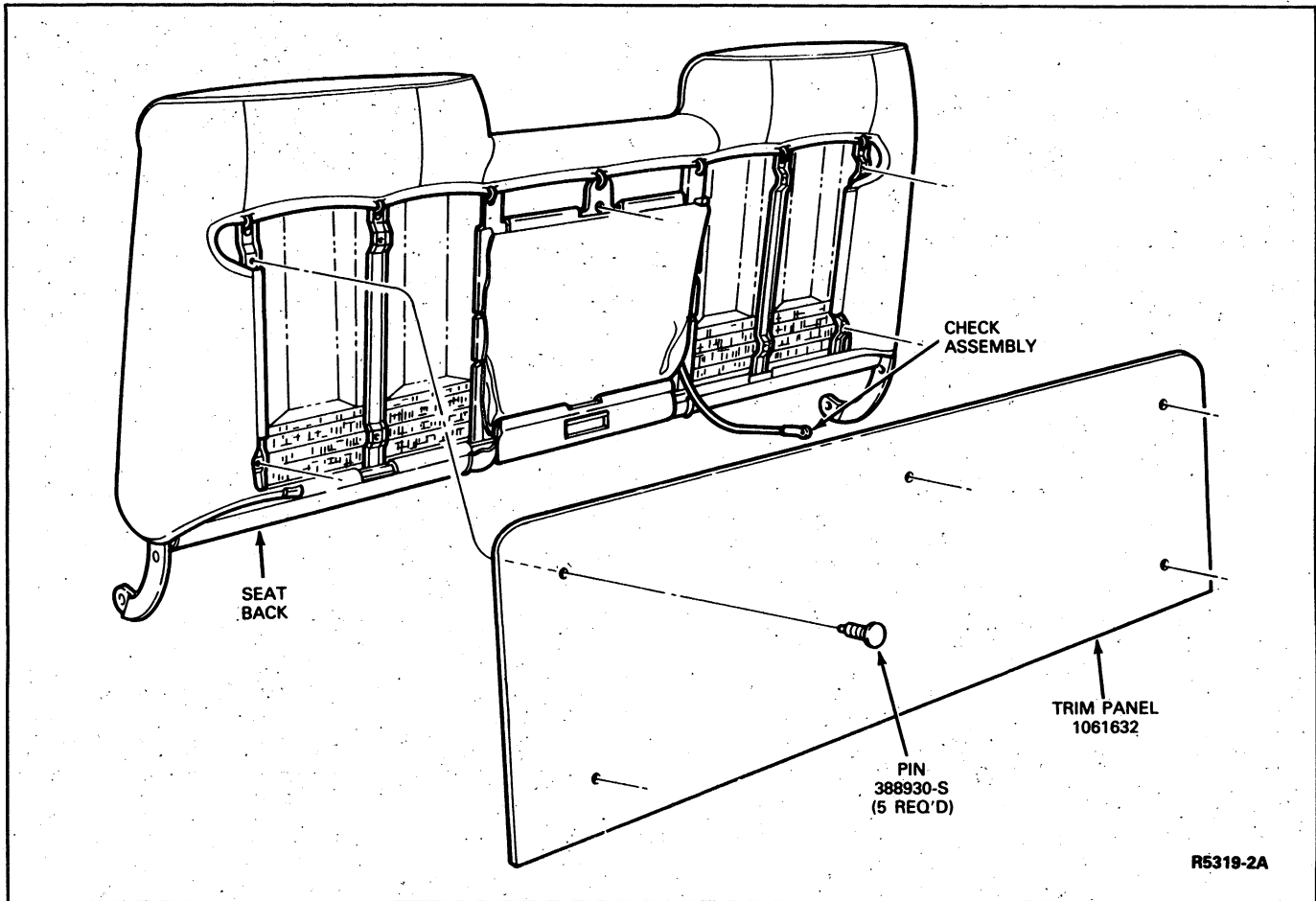


FIG. 5 Center Arm Rest, Seat Back Cover Installation—F-Series

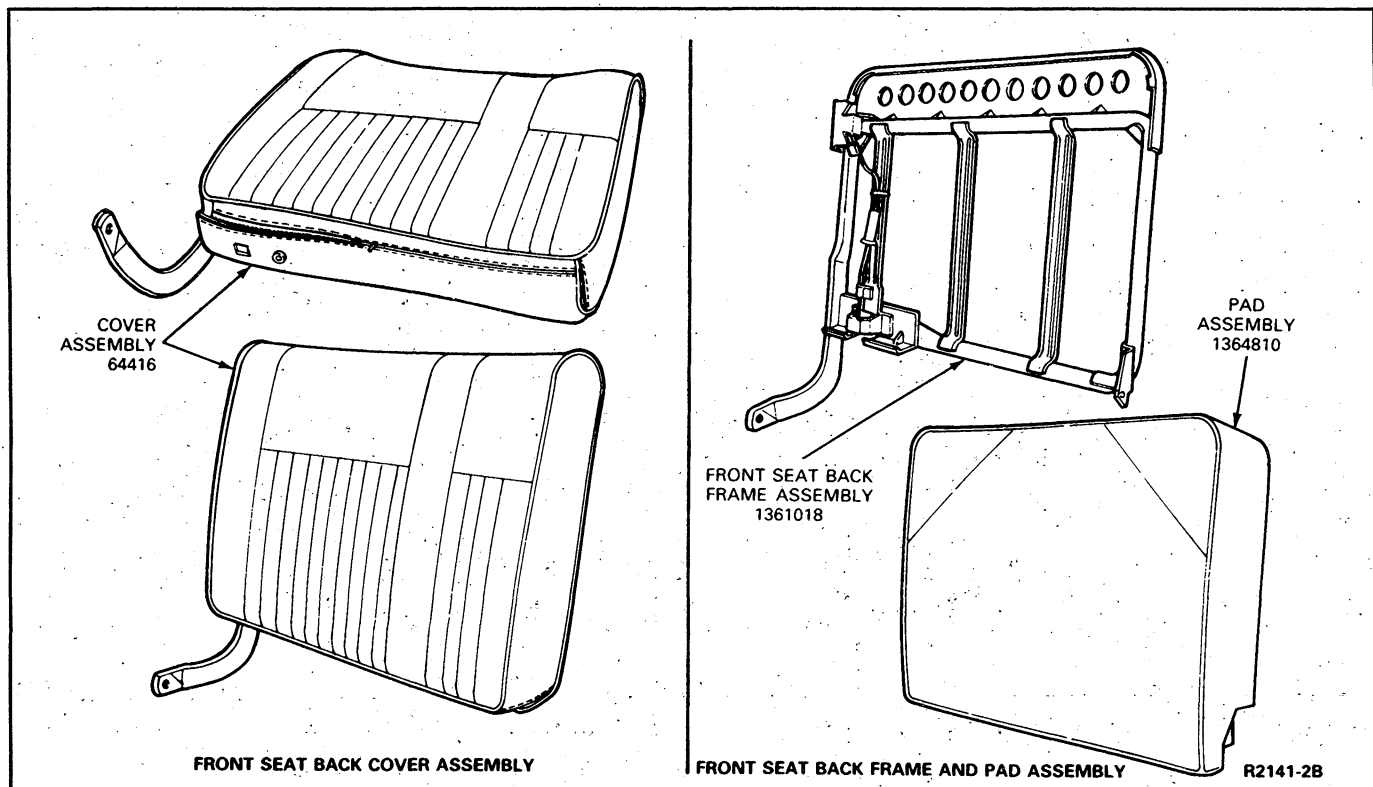


FIG. 6 Front Seat Back Frame, Pad and Cover—F-150—F350, Super Cab and Bronco

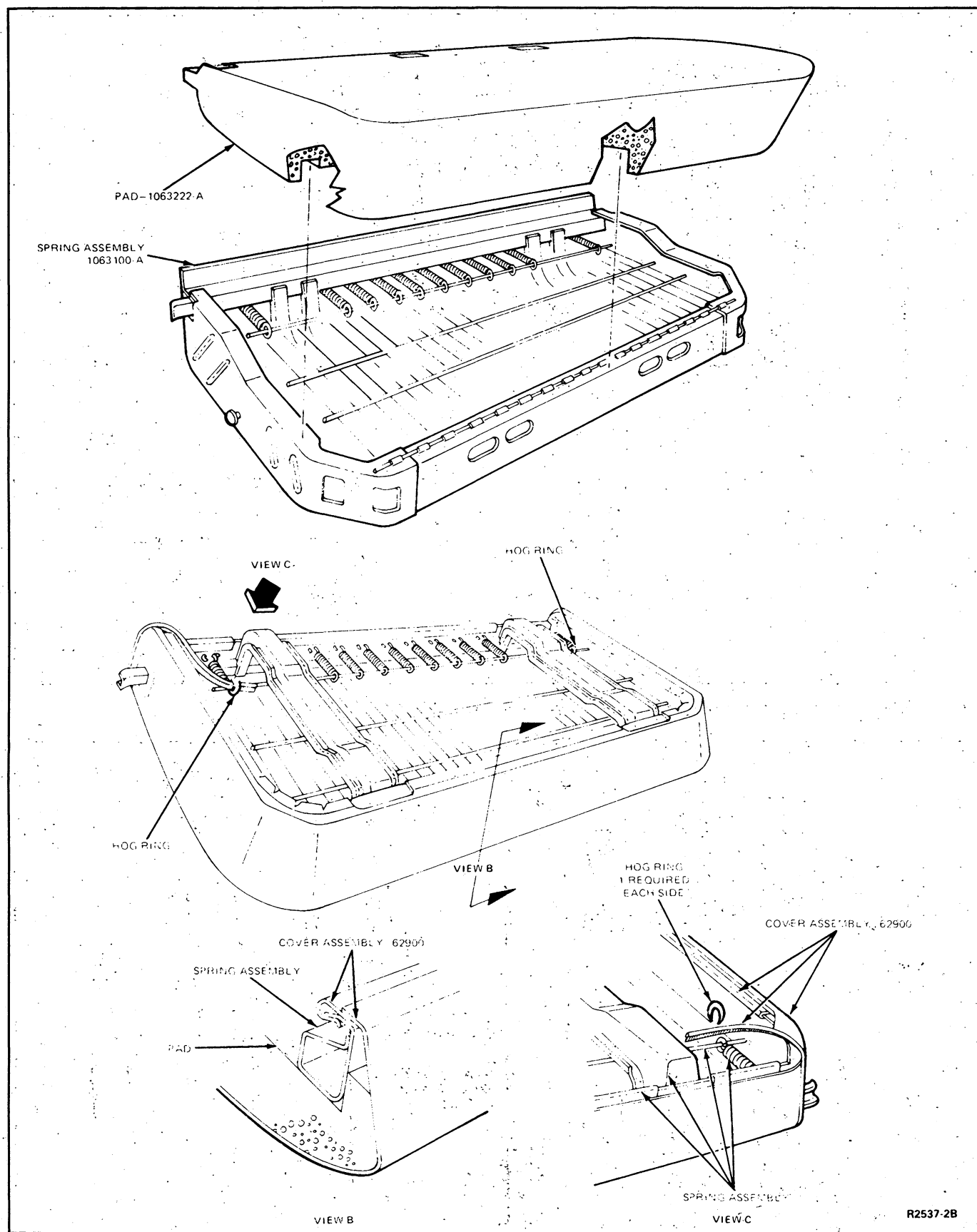
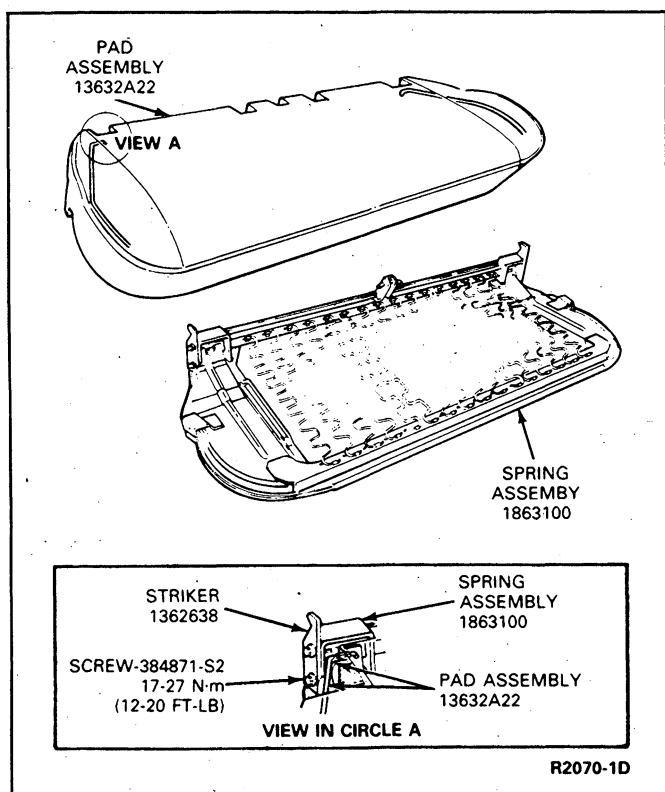


FIG. 7 Front Seat Cushion Cover Installation—F-150—F-350 with Conventional Cab



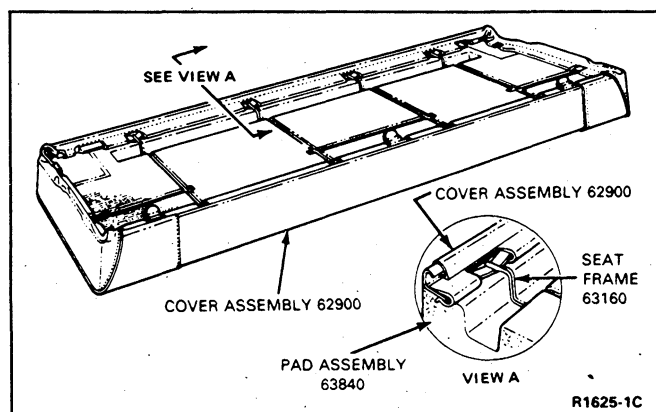
**FIG. 8 Front Seat Cushion Cover Installation—F-150—F-350 Super Cab**

5. Position the new pad to the seat back assembly. Fasten pad in place with hog rings.
6. Transfer the listing wires from the old cover to the listings in the new cover.
7. Position the cover over the spring assembly. Fasten cover with hog rings.
8. Install the seat back to the seat cushion.
9. Install the seat and track assembly into the vehicle. Tighten attaching screws and washers to specifications. Refer to Sections 41-01, Front Seats; 41-14, Conventional Rear Seats and 41-20 Folding Rear Seats.

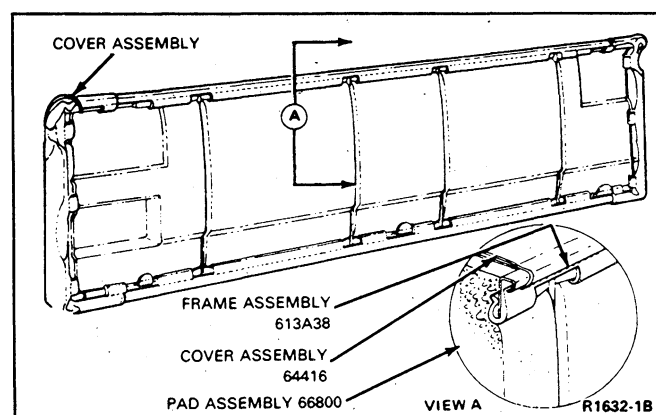
### Seat Back Cover—Bench Seat

#### Bronco, F-150—F-350 and E-150—E-350

1. Remove the seat back-to-cushion mounting bolts and washers. Separate the back from the cushion and lift the seat back out of the vehicle.



**FIG. 9 Rear Seat Cushion Cover Installation—F-150—F-350 Super Cab**



**FIG. 10 Rear Seat Back Cover Installation—F-150—F-350 Super Cab**

2. Cut the hog rings attaching the cover to the seat back or cushion spring assembly (Figs. 13, 14, 15 and 16). Remove the seat back cover.
3. Remove plastic retainers and front seat back trim panel.
4. Transfer the listing wires from the old cover to the listings in the new cover.
5. Position the new cover over the padding. Pull cover tight, and fasten the cover to the spring assembly with hog rings.
6. Install front seat back trim panel.
7. Install the seat back to the seat cushion assembly.

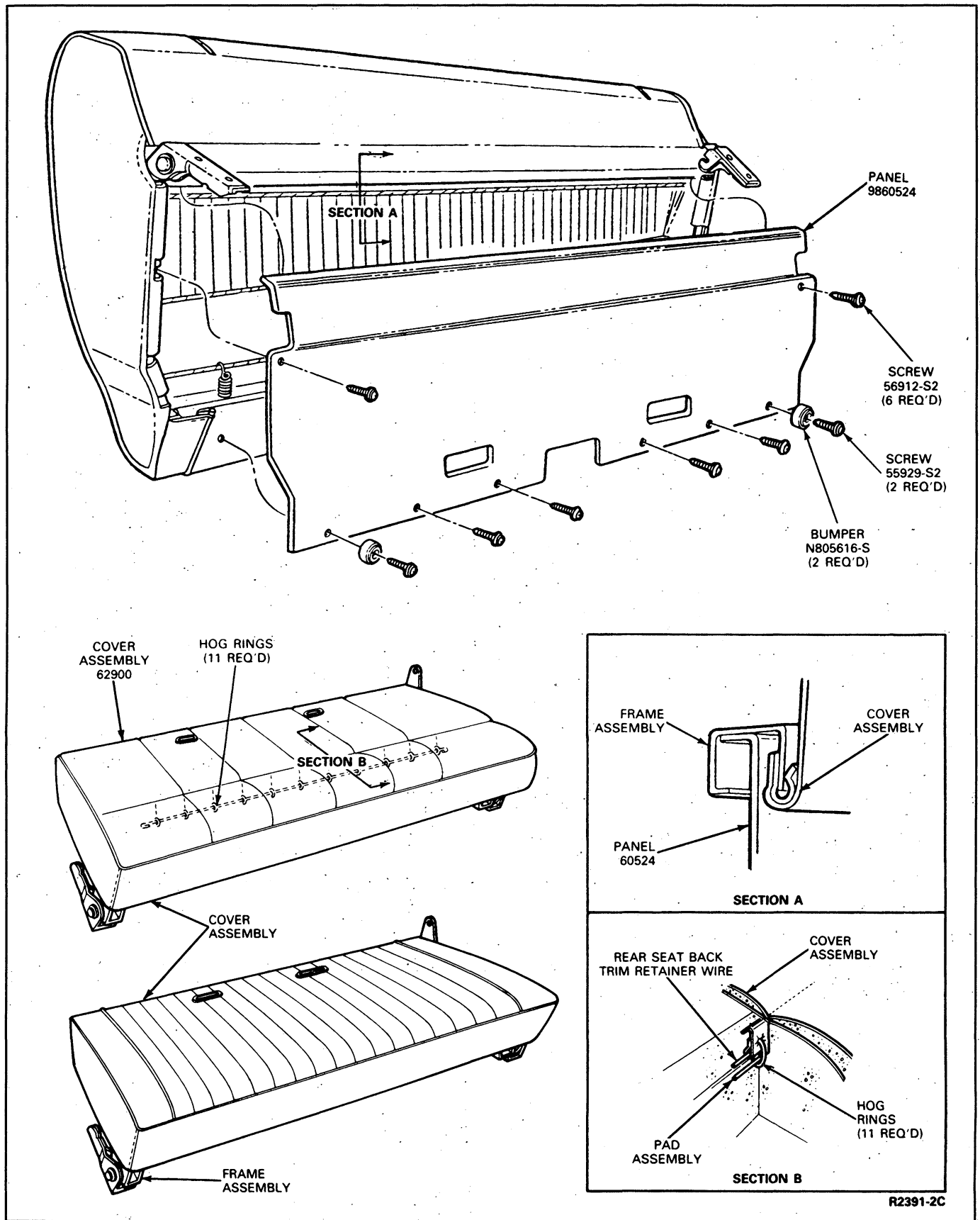


FIG. 11 Rear Folding Seat—Bronco

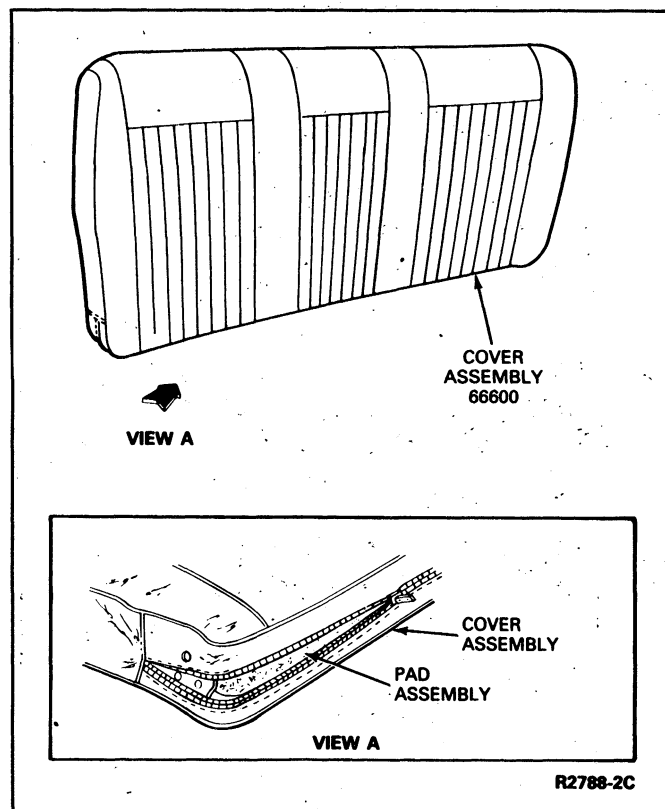


FIG. 12 Rear Seat Back Cover Assembly—Bronco

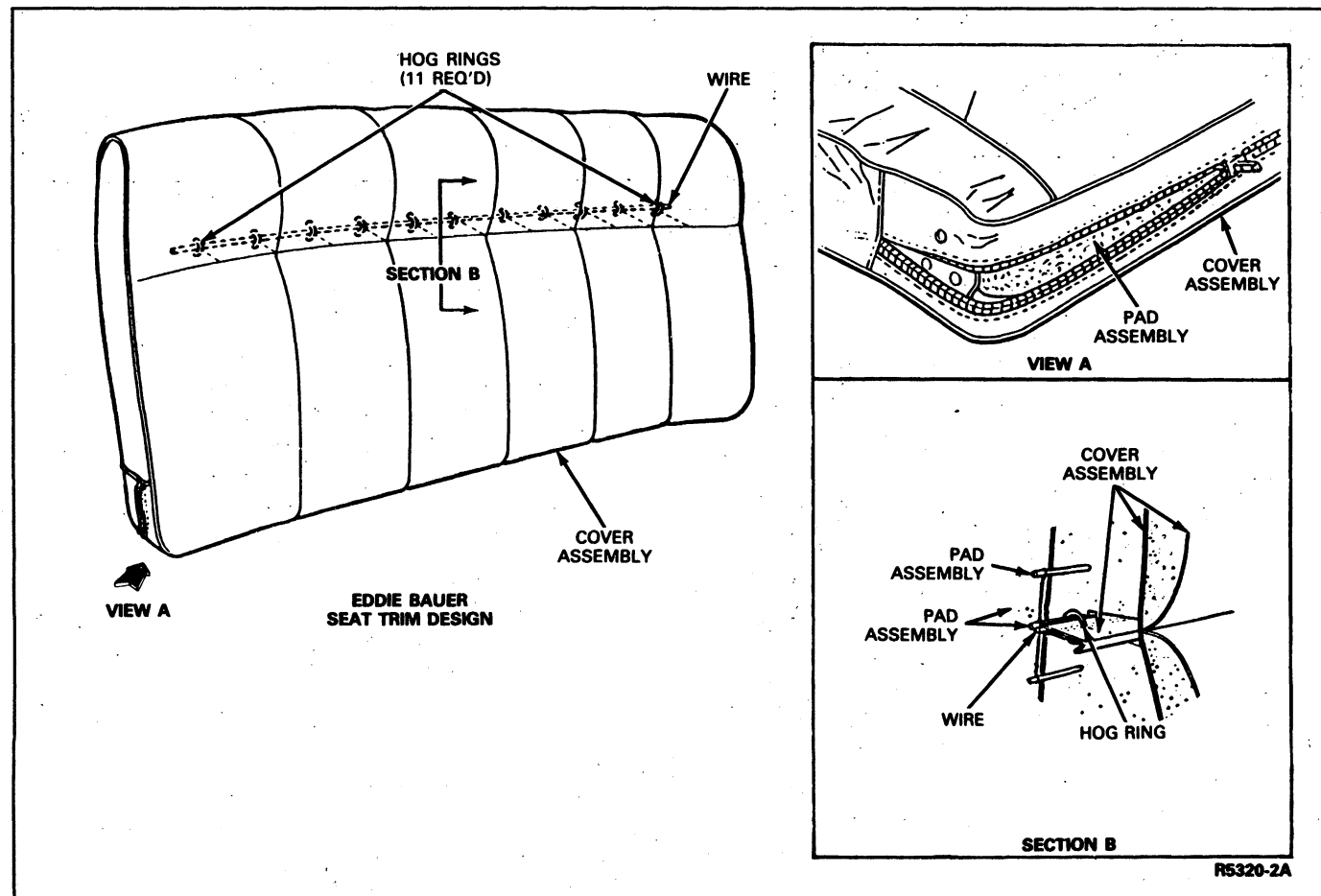


FIG. 13 Rear Seat Back Cover Assembly—Bronco

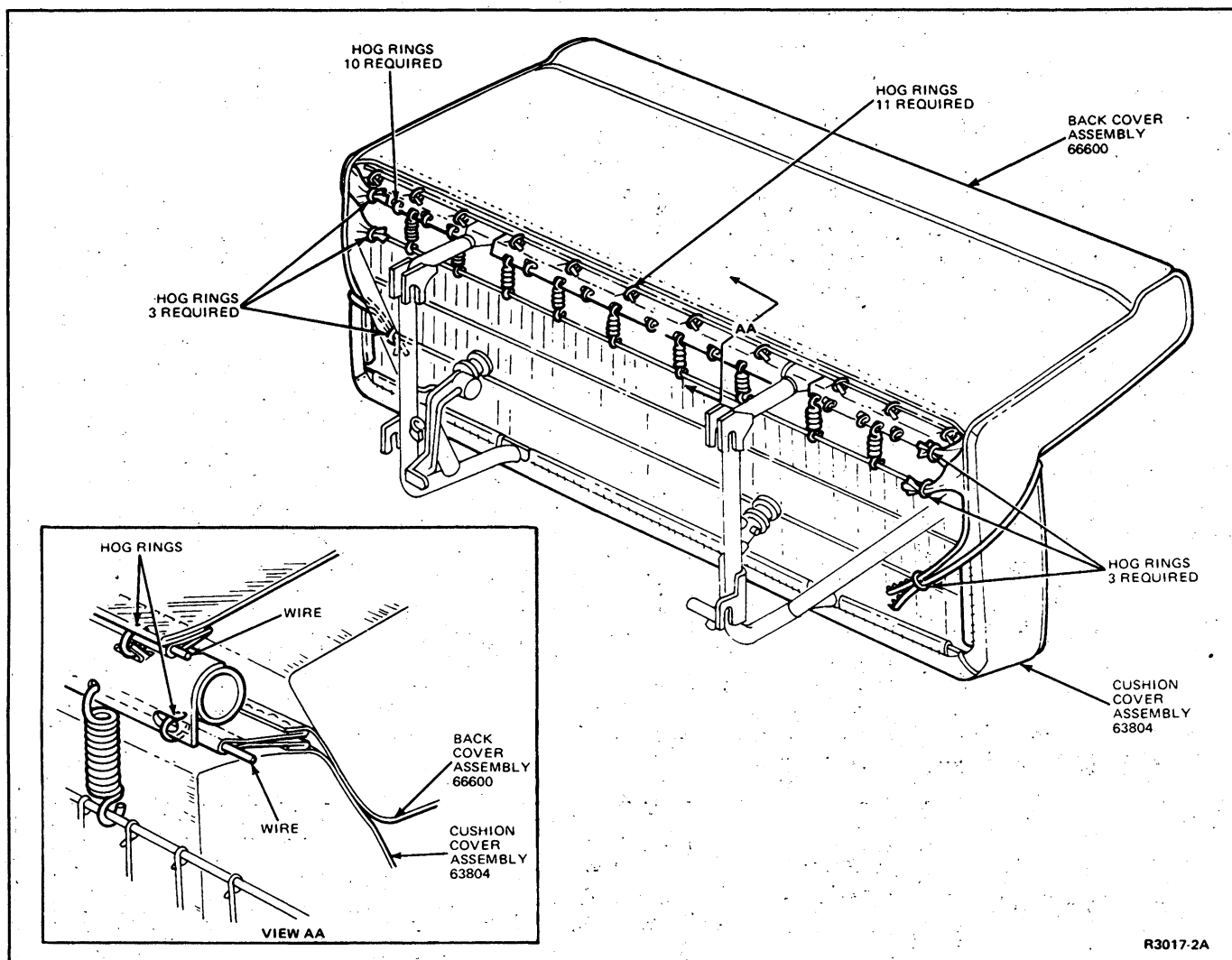


FIG. 14 Rear Seat Cover Assemblies—E-150—E-350 (Three Passenger Seats)

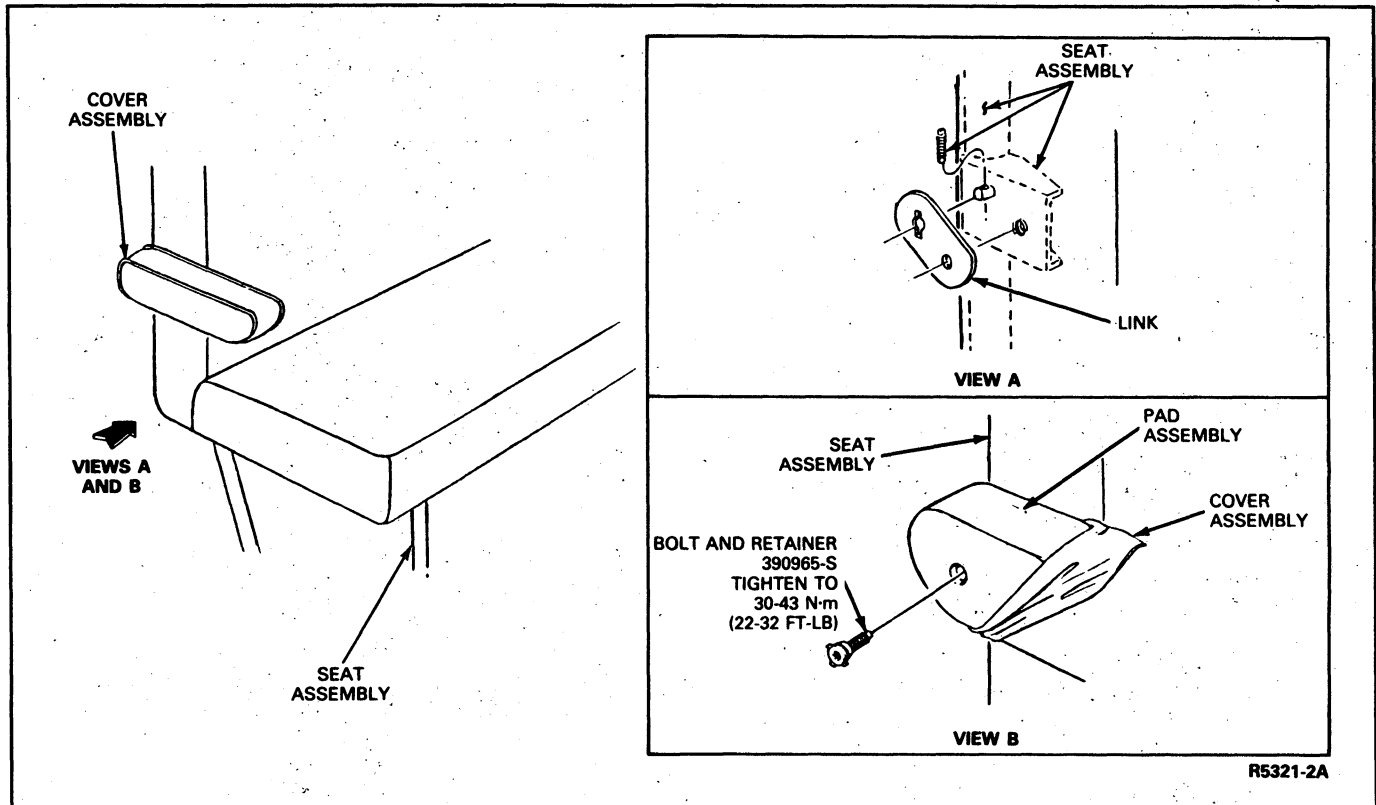


FIG. 15 Rear Seat Arm Rest—E-Series (Three Passenger Seats)

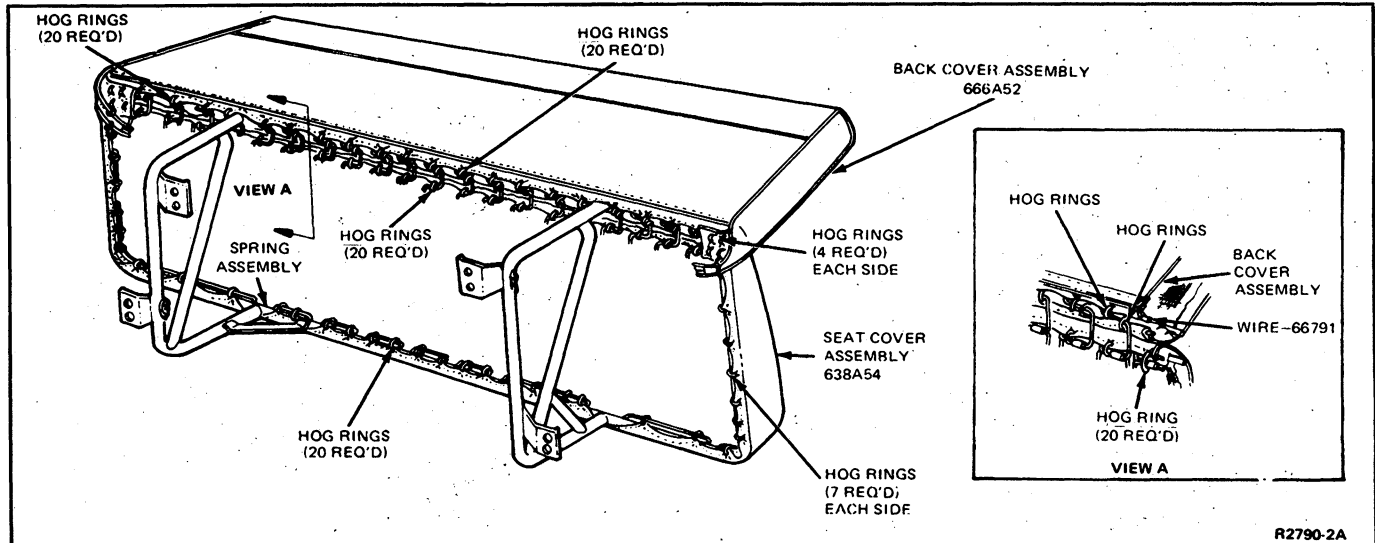


FIG. 16 Rear Seat Cover Assemblies—E-150—E-350 (Four Passenger Seats)

# WINDOW GLASS AND MECHANISMS

## GROUP **42**

(70000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
FRONT DOOR WINDOW GLASS AND MECHANISMS .....	42-04-1	TAILGATE WINDOW MECHANISMS .....	42-35-1
PIVOT TYPE REAR DOOR AND SIDE WINDOW .....	42-25-1	VENT WINDOW MECHANISM .....	42-15-1
POWER WINDOWS .....	42-08-1	WINDOW GLASS AND MECHANISMS GENERAL SERVICE .....	42-01-1
REAR DOOR WINDOW GLASS AND MECHANISMS .....	42-30-1		

## SECTION 42-01 Window Glass and Mechanisms General Service

SUBJECT	PAGE	SUBJECT	PAGE
LUBRICATION Window Mechanism .....	42-01-1	VEHICLE APPLICATION .....	42-01-1

### VEHICLE APPLICATION

All Models.

### LUBRICATION

#### Window Mechanism

The door window mechanism should be properly lubricated to provide ease of operation. The window glass mechanism should be lubricated whenever the glass channel or window regulator is removed, or excessive effort is required to operate the windows. To lubricate a door window mechanism, apply an even coating of Lithium Complex Polymer Additive Grease ESB-M1C208-1A or equivalent to the window regulator rollers, shafts and the entire length of the roller guides as illustrated by the shaded areas in Fig. 1.

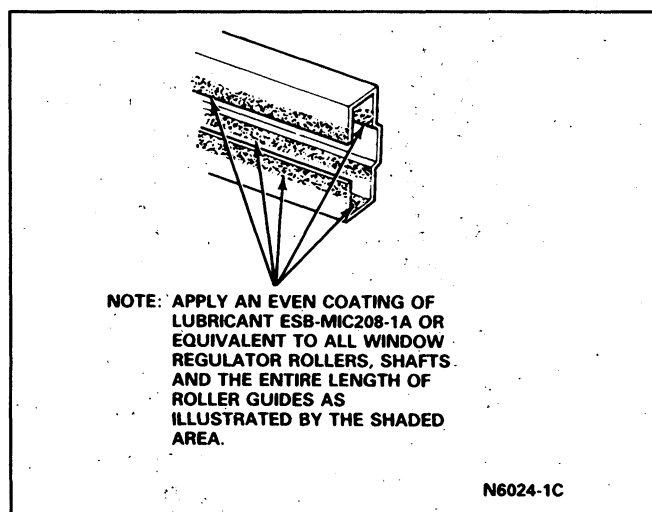


FIG. 1 Window Mechanism Lubrication



# SECTION 42-04 Front Door Window Glass and Mechanisms

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Window Mechanism .....	42-04-1	Front Door Glass (Cont'd)	
E-150—E-350, F150-F350, F-Super Duty and Bronco .....	42-04-1	E-150—E-350 .....	42-04-2
<b>REMOVAL AND INSTALLATION</b>		Power Window Regulator Motor F-150—F-350, F-Super Duty and Bronco .....	42-04-4
Door Glass Belt Weatherstrip .....	42-04-4	Window Regulator .....	42-04-4
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Front Door Glass .....	42-04-2	<b>SPECIAL SERVICE TOOLS</b> .....	42-04-5
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## VEHICLE APPLICATION

E-150—E-350, F-150—F-350, F-Super Duty and Bronco

## ADJUSTMENTS

### Window Mechanism

E-150—E-350, F150-F350, F-Super Duty and Bronco

1. Remove the trim panel from the door, if so equipped.
2. Remove the watershield from the door.
3. Loosen the front division bar lower attaching screw and the rear run retainer lower attaching screw (Figs. 1 and 2).
4. Lower the window glass until the top edge of the glass is approximately 101mm (4 inches) above the belt line (Figs. 1 and 2).
5. Tighten the screws (Figs. 1 and 2) and check the operation of the window mechanism.
6. Install the trim panel and watershield on the door.

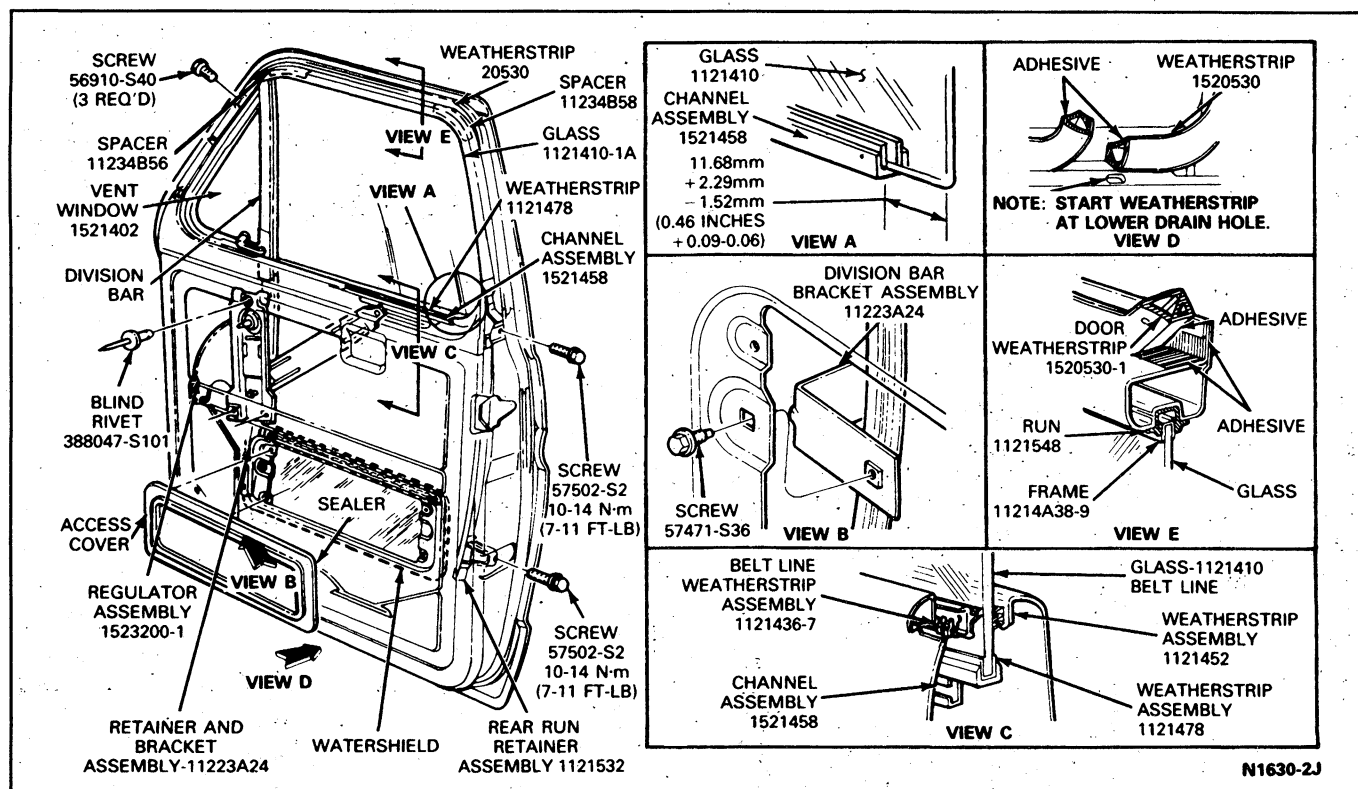


FIG. 1 Front Door Window Glass Adjustment—E-150—E-350

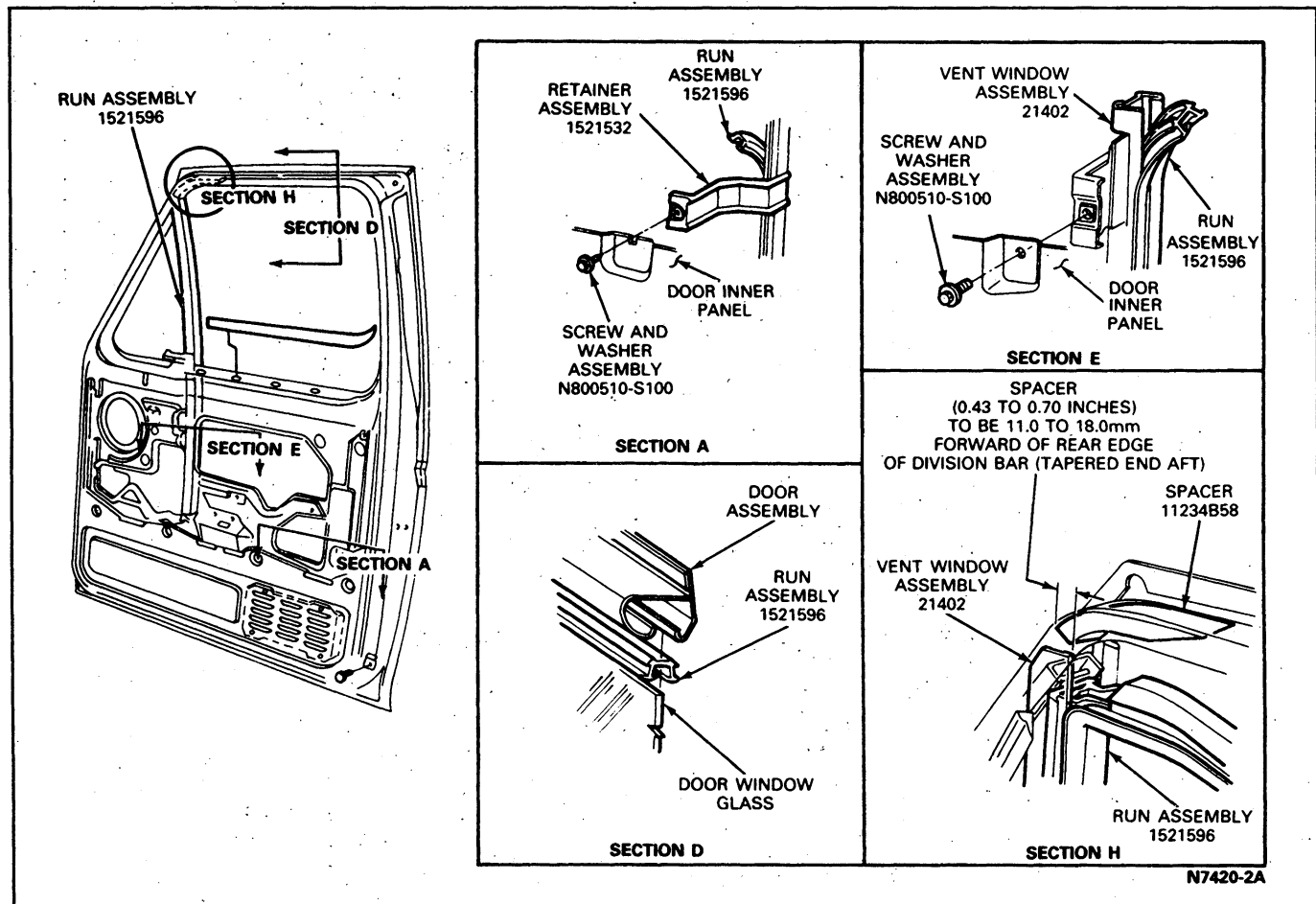


Fig. 2 Door Glass Adjustment—F-150—F-350 F-Super Duty and Bronco

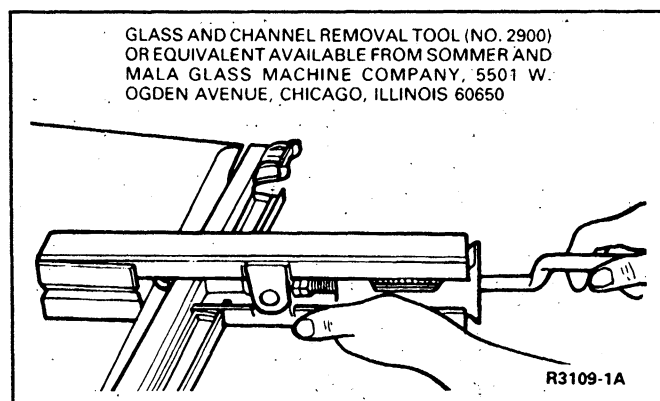


FIG. 3 Glass Channel Replacement

## REMOVAL AND INSTALLATION

### Front Door Glass

#### E-150—E-350

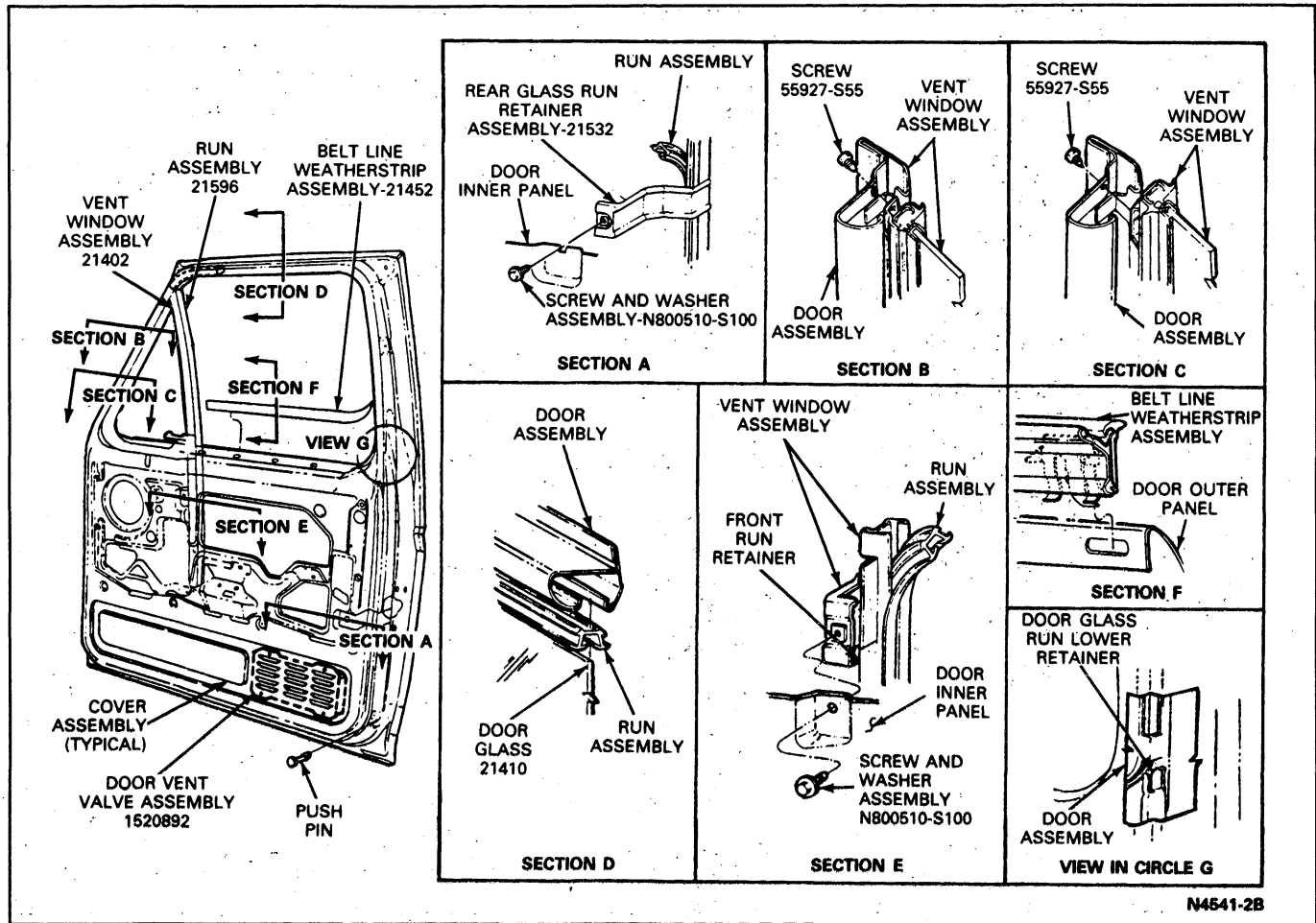
#### Removal

1. Remove the door trim panel.
2. Remove three screws attaching the vent window assembly to the upper leading edge of the door (Fig. 1).
3. Remove one screw attaching the front run division bar bracket to the door (Fig. 1, View B).

4. Lower door glass to DOWN position.
5. Pull rear run down and out of the run slot along the top of the glass opening.
6. Tilt the vent window and division bar assembly rearward. Then, remove the vent window and division bar from the door.
7. Unsnap and remove belt weatherstrip.
8. Rotate the front edge of the glass downward, and lift the glass and channel assembly from the door, sliding the glass channel off the regulator arm roller.
9. Remove the glass channel from the glass using Glass and Channel Removal Tool 2900 or equivalent (Fig. 3).

#### Installation

1. Install the glass channel onto the glass using Glass and Channel Removal Tool 2900 or equivalent (Fig. 3).
2. Lubricate the window mechanism. Refer to Section 42-01, Window Glass and Mechanisms—General Service.
3. Position the glass and channel assembly into the door, inserting the regulator arm roller into the glass channel.
4. Position the vent window and division bar into the door.



**FIG. 4 Door Glass and Vent Window Installation—Bronco and F-150—F-350 Truck**

5. Position the rear run retainer into the door, and install the attaching screw.
6. Position the glass and channel assembly into the front division bar, and the rear run. Then, place the vent window assembly into position in the door, and install the three vent frame attaching screws.
7. Insert the front run in the division bar.
8. Install the screw attaching division bar bracket to the door.
9. Adjust the window glass as outlined.
10. Install the door trim panel, if so equipped.
6. Rotate the front edge of the glass downward and lift the glass from the door.
7. Remove the glass from the glass channel using Glass and Channel Removal Tool 2900 or equivalent (Fig. 3).

#### **Bronco, F-150—F-350 and F-Super Duty**

##### **Removal**

1. Remove the door trim panel.
2. Remove the screw from the front division bar (Fig. 4, View E).
3. Remove two vent window assembly attaching screws from the front edge of the door (Fig. 4, Views B and C).
4. Lower the door glass and pull the glass run out of the run retainer near the vent window division bar enough to allow removal of the vent window assembly.
5. Tilt the vent window and division bar assembly toward the rear of the door and remove the vent window from the door.

##### **Installation**

1. Install the glass in the glass channel using Glass and Channel Removal Tool 2900 or equivalent (Fig. 3).
2. Position the glass and channel assembly into the door, inserting the regulator arm roller into the slot of the glass channel (Fig. 5, View A).
3. Position the vent window and division bar into the door and insert the front edge of the glass into the division bar (front) run.
4. Install the two vent window attaching screws at the forward edge of the door (Fig. 4, Views B and C).
5. Insert the glass run into the run retainer near the division bar (Fig. 4, View E).
6. Install the screw at the front run retainer (Fig. 4, View E). Adjust as outlined.
7. Check the operation of the window and install the door trim panel.

## Door Glass Belt Weatherstrip

E-150—E-350

### Removal

1. Remove the trim panel from the door inner panel.
2. Lower glass to full down position.
3. Unsnap and remove the belt line weatherstrip(s) from the door (Fig. 1).

### Installation

1. Position the weatherstrip to the door and snap into place.
2. Install the trim panel onto the door inner panel.

## Window Regulator

E-150—E-350, F-150—F-350 F-Super Duty and Bronco

### Removal

1. Remove door trim panel and access cover, if so equipped.
2. Support glass in the full up position.
3. Remove center pin from regulator attaching rivets with drift punch. Then, drill head from each rivet

using a 6.35mm (1/4-inch) drill and remove rivet. Be careful not to damage sheet metal holes during drilling (Fig. 5).

4. Disengage regulator arm from glass bracket and remove regulator.

### Installation

1. Position regulator in door and insert arm into glass bracket channel (Fig. 5).
2. Position regulator to inner panel and install rivets using Rotunda Hydraulic Rivet Gun 107-00600 or equivalent to attach regulator to inner panel. A 1/4 inch -20 x 1/2 inch screw and washer assembly and a 1/4 inch -20 nut and washer assembly may be used in place of the rivets if rivets are not available (equivalent metric retainers may also be used).
3. Check operation of window mechanism and install door trim panel.

## Power Window Regulator Motor F-150—F-350, F-Super Duty and Bronco

Refer to Section 42-08, Power Windows for removal and installation procedures.

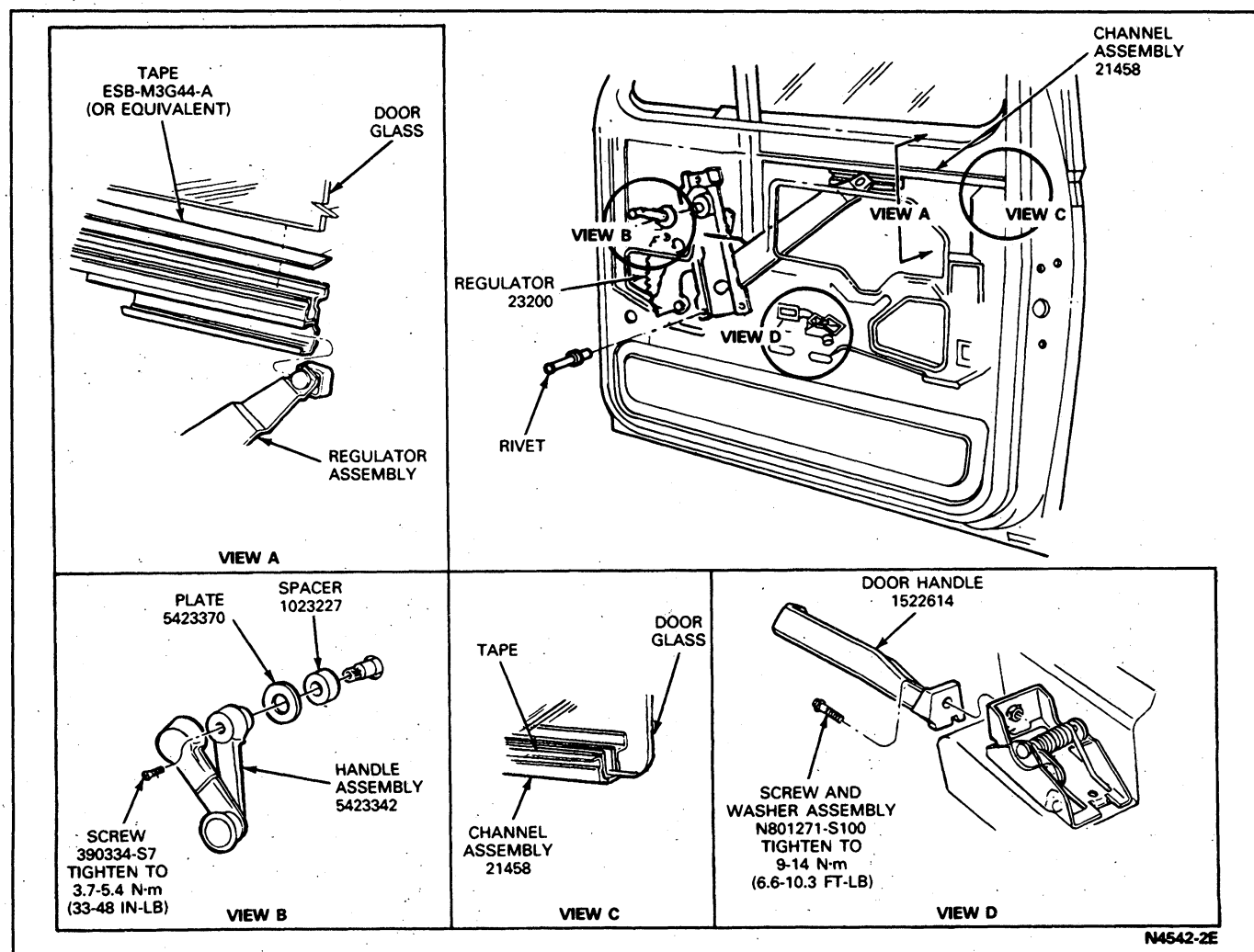


FIG. 5 Window Regulator—Removal and Replacement—F-150—F-350, F-Super Duty and Bronco Shown—E-150—E-350 Similar

**SPECIAL SERVICE TOOLS**

Tool Number	Description
2900	Glass and Channel Removal Tool

CN6016-1A

**ROTUNDA EQUIPMENT**

Model	Description
107-00600	Hydraulic Rivet Gun

CN5976-1B

# SECTION 42-08 Power Windows

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>TESTING (Cont'd)</b>	
Power Window Motor .....	42-08-5	Power Window Switch Tests .....	42-08-1
Power Window Switch Connector		Multiple Switch For E-150—E-350	
Wire .....	42-08-3	Econoline Only .....	42-08-1
Power Window Switch E-150—E-350 .....	42-08-3	Single Switch—E-150—E-350 .....	42-08-2
Power Window Switch F-150—F-350,		Window Switch—F-150—F-350, F-Super	
F-Super Duty and Bronco .....	42-08-3	Duty and Bronco .....	42-08-2
<b>SPECIAL SERVICE TOOLS</b> .....	42-08-7	<b>VEHICLE APPLICATION</b> .....	42-08-1
<b>TESTING</b>			
Power Window Motor Test .....	42-08-2		

## VEHICLE APPLICATION

All F-150—F-350, F-Super Duty E-150—E-350 and Bronco Models.

## TESTING

### Power Window Switch Tests

#### Multiple Switch For E-150—E-350 Econoline Only

#### Test Procedure

Testing of the power window multiple switch should be performed with the switch removed from the vehicle. Use a self-powered test lamp or a Rotunda 007-00001, Digital Volt-Ohm Meter, or equivalent.

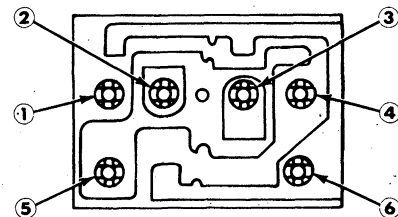
- Clip one test lead probe on pin No. 6 (Fig. 1) which is grounded.
- With both switches in the neutral position, pins No. 1 through 4 should have continuity to pin No. 6.
- Push both window switches upward (toward window when in installed position). Both pins No. 1 and 3 should have no continuity to pin No. 6.
- Push both window switches downward (away from window when in installed position). Both pins No. 2 and 4 should have no continuity to pin No. 6.
- Remove the test lead from pin No. 6 and connect to pin No. 5 (hot feed pin). With both switches in the neutral position, pin No. 5 should have continuity only with itself.
- Push both window switches upward (toward the window when in installed position). Both pins No. 1 and 3 should have continuity to pin No. 5.
- Push both window switches downward (away from the window when in installed position). Both pins No. 2 and 4 should have continuity to pin No. 5.
- If any one switch does not test as stated, replace the complete switch assembly.

CONNECT ONE SIDE OF AN OHMMETER SELF-POWERED OR TEST LAMP TO TERMINAL NO. 5 (BATTERY TERMINAL) AND THE OTHER SIDE TO THE TERMINALS SHOWN BELOW.

WINDOW SWITCH POSITION	CONTINUITY BETWEEN TERMINALS
NEUTRAL	NO. 5
RIGHT FRONT — UP	NO. 3
RIGHT FRONT — DOWN	NO. 4
LEFT FRONT — UP	NO. 1
LEFT FRONT — DOWN	NO. 2

CONNECT ONE SIDE OF AN OHMMETER SELF-POWERED OR TEST LAMP TO TERMINAL NO. 6 (GROUND TERMINAL) AND THE OTHER SIDE TO THE TERMINALS SHOWN BELOW.

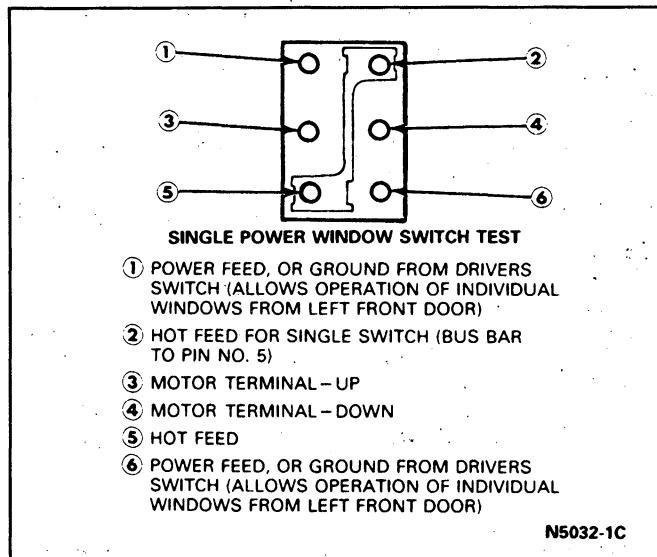
WINDOW SWITCH POSITION	CONTINUITY BETWEEN TERMINALS
NEUTRAL	NOS. 1, 2, 3, 4
RIGHT FRONT — UP	NOS. 1, 2 AND 4
RIGHT FRONT — DOWN	NOS. 1, 2 AND 3
LEFT FRONT — UP	NOS. 2, 3 AND 4
LEFT FRONT — DOWN	NOS. 1, 3 AND 4



1. LEFT FRONT "UP" TERMINAL
2. LEFT FRONT "DOWN" TERMINAL
3. RIGHT FRONT "UP" TERMINAL
4. RIGHT FRONT "DOWN" TERMINAL
5. HOT FEED WHEN IGNITION SWITCH IS "ON"
6. GROUND TERMINAL

N5031-2F

FIG. 1 Power Window Multiple Switch Pin Connections and Locations—E-150—E-350



**FIG. 2 Power Window Single Switch Pin Locations—E-150—E-350**

### Single Switch—E-150—E-350

#### Test Procedure

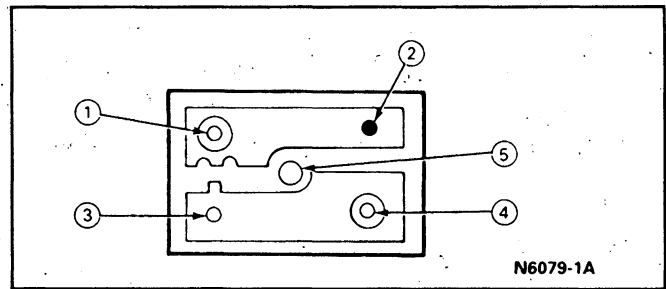
1. Use a self-powered test lamp or an ohmmeter, to test the power window switch.
2. With the switch in the neutral position, there should be continuity between terminals 1 and 3, 2 and 5, and 4 and 6 (Fig. 2).
3. With the toggle switch pushed downward, there should be continuity between terminals 2, 4 and 5, and 1 and 3. Terminal 6 should be disconnected from any other terminal.
4. With the toggle switch pushed upward, there should be continuity between terminals 2, 3 and 5, and 4 and 6. Terminal 1 should be disconnected from any other terminal.
5. If the switch does not test as stated, replace the switch.

### Window Switch—F-150—F-350, F-Super Duty and Bronco

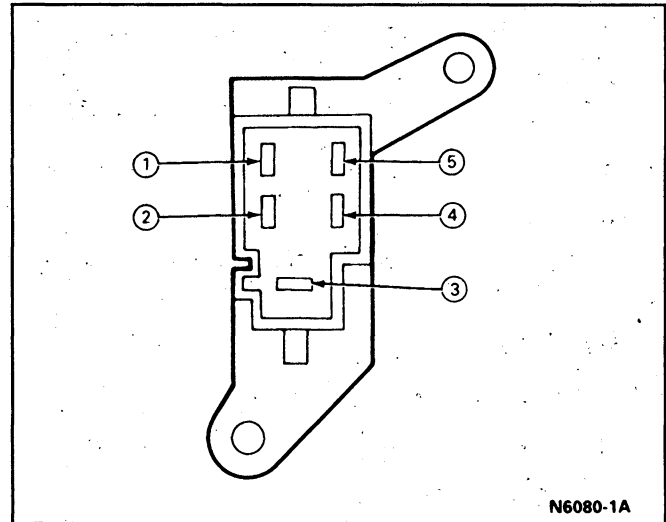
#### Test Procedure

NOTE: The switch should be oriented so that the raised portion of the switch knob is to the right and you are looking at the five terminals.

1. Use a self-powered test lamp or an ohmmeter to test the power window switch (Fig. 3).
2. With the switch in the neutral position, there should be continuity between terminals 1 & 2 and terminals 3 & 4. Terminal 5 should be disconnected from all other terminals.
3. When the raised portion of the switch rocker knob is pushed (to close the windows), there should be continuity between terminals 1 & 5 and terminals 3 & 4. Terminal 2 should be disconnected from all other terminals.
4. When the depressed portion of the switch rocker knob is pushed (to open the windows), there should be continuity between terminals 1 & 2 and terminals 4 & 5. Terminal 3 should be disconnected from all other terminals.



**FIG. 3 Power Window Switch Pin Locations—F-150-F-350, F-Super Duty and Bronco**



**FIG. 4 Tailgate Switch Terminal Locations—Bronco**

5. If the switch assembly does not test as stated, replace the switch.

### Instrument Panel-Mounted Tailgate Switch—Bronco

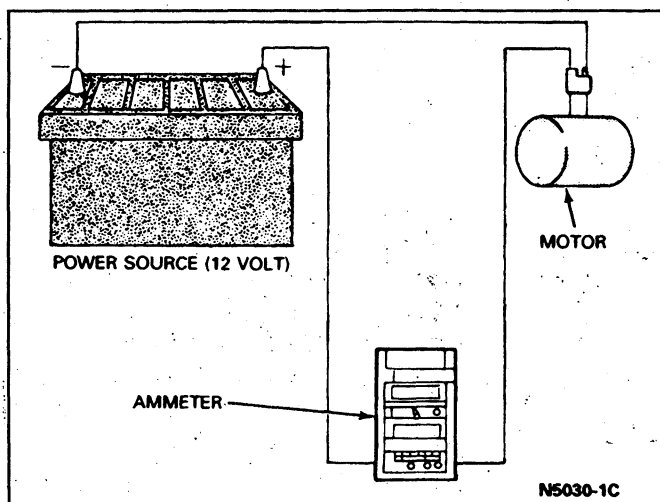
1. Use a self-powered test lamp, or an ohmmeter to test the power tailgate switch (Fig. 4).
2. With the switch in the neutral position, there should be continuity between terminals 1 & 2 and terminals 3 & 4. Terminal 5 should be disconnected from all other terminals.
3. When the switch rocker knob is pushed up (to close the tailgate window), there should be continuity between terminals 1 & 2 and terminals 4 & 5. Terminal 3 should be disconnected from all other terminals.
4. When the switch rocker knob is pushed down (to open the tailgate window), there should be continuity between terminals 2 & 5 and terminals 3 & 4. Terminal 1 should be disconnected from all other terminals.
5. If the switch does not test as stated, replace the switch.

### Power Window Motor Test

To test the current draw of a power window motor, remove the door trim panel. Refer to Section 45-03, Door Trim Panels.

#### Test Procedure

1. Disconnect the motor lead.



**FIG. 5 Power Window Motor Current Draw Test—Permanent Magnet-Type**

2. Disconnect the regulator mechanism from the motor.
3. Supply power to motor lead connector with an ammeter in series (Figs. 5 and 6).
4. Operate the motor and observe the current draw. The current draw for the no-load test should not exceed four amps and should not fluctuate. Reversal of the motor wire connections will reverse the direction of motor rotation. Replace the motor if the current draw exceeds four amps.

## REMOVAL AND INSTALLATION

### Power Window Switch E-150—E-350

#### Removal and Installation

1. To remove the power window switch, remove the bezel retaining screw (Fig. 7). Then, lift the bottom of the bezel from the door trim panel and remove the switch and bezel assembly.
2. Remove the wiring connector retaining screw from the back of the bezel. Then, using a thin-bladed screwdriver, carefully pry the switch from the connector.
3. To install, reverse Steps 1 and 2.

### Power Window Switch F-150—F-350, F-Super Duty and Bronco

#### Removal and Installation

Refer to Fig. 8.

The power window switches are located on the front door trim panels.

#### Removal

1. Insert a small, thin-bladed screwdriver into spring tab slots (located at front & rear of switch housing) and apply pressure to make the switch housing assembly pop out.
2. Remove three connector attaching screws from switch housing.
3. The switch is held in place by the electrical contact pins. To remove switch, carefully pry switch from connector with a small screwdriver.

#### Installation

1. Position switch to connector and press firmly into place.  
NOTE: The switch is keyed to the connector and can only be installed one way.
2. Install connector to the switch housing using three attaching screws.
3. Position switch housing to door trim panel and press firmly into place.

### Instrument Panel-Mounted Tailgate Switch—Bronco

#### Removal and Installation

The tailgate switch is located in the lower left finish panel on the instrument panel.

#### Removal

1. Remove headlamp switch knob and windshield wiper switch knob by releasing knob retaining clips and pulling knobs from their switch shafts.
2. Using a thin-bladed screwdriver (on a small putty knife) carefully pry off lower left finish panel by starting at upper left corner of finish panel and working counterclockwise around perimeter of finish panel.

NOTE: The finish panel is held in place by four retaining clips on the instrument panel, holding four plastic fingers on the finish panel. Care should be taken not to break the four plastic fingers when prying the finish panel off.

3. Remove two switch retaining screws and remove switch from finish panel.
4. Separate switch assembly from wiring harness by grasping wiring harness in one hand (close to the switch), switch in the other hand and pulling them apart.

#### Installation

1. Position wiring connector to switch and push them firmly together.
2. Position switch to finish panel and install two retaining screws.
3. Position finish panel to instrument panel, taking care to align four plastic fingers with four retaining clips and press firmly into place.
4. Reinstall headlamp switch knob and windshield wiper switch knob.

### Power Window Switch Connector Wire

#### Removal and Installation

If replacement of the switch connector or a wire leading to the connector is necessary, the wire(s) can be removed from the connector without disassembling the connector.

To remove a wire from the connector, insert a needle-like tool in the edge of the pin hole (Fig. 9), and bend the terminal in. Then, pull the wire and terminal from the connector. To install the terminal in the connector, open the terminal and insert it into the wire hole.



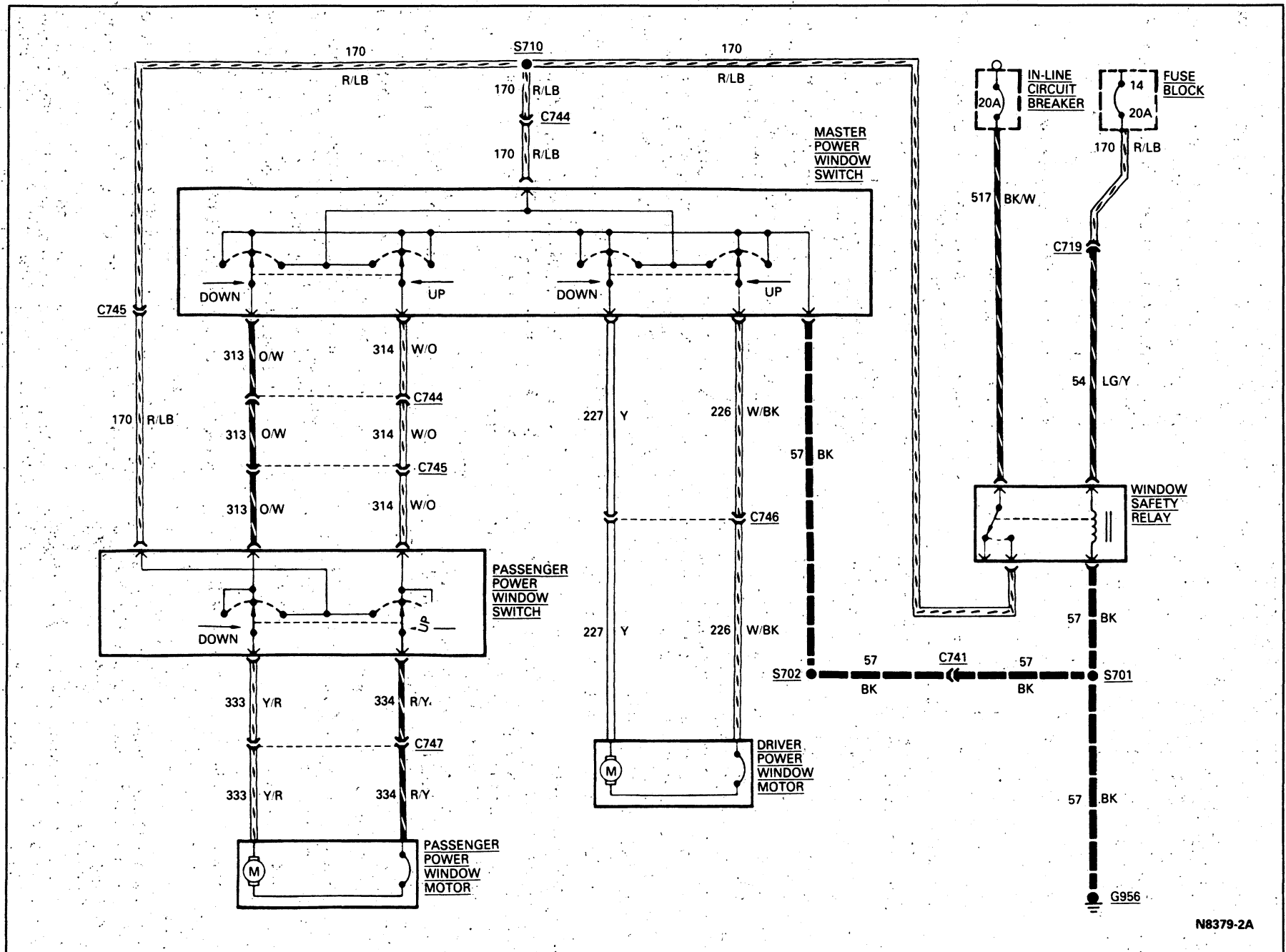


FIG. 6 Power Windows—Electric Schematic—E-150—E-350

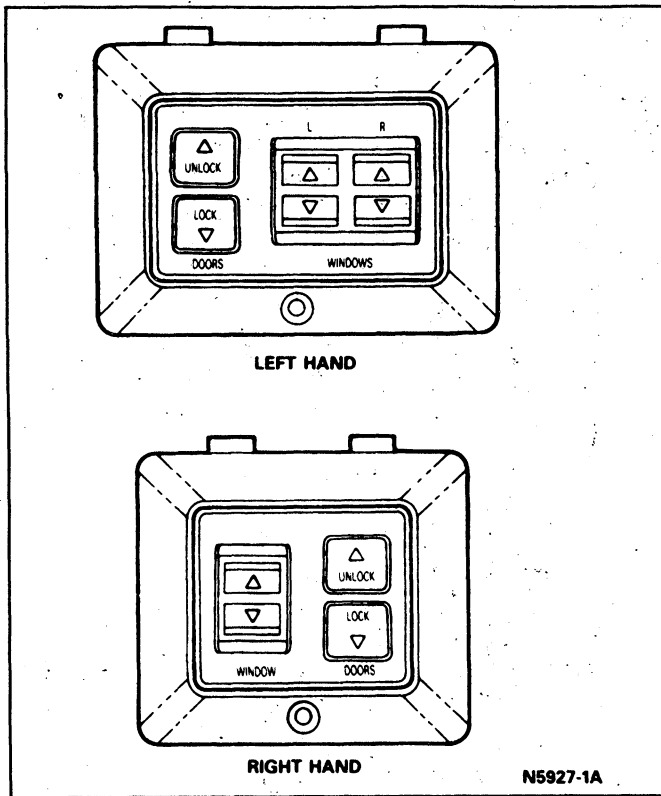


FIG. 7 Power Window Switches—E-150—E-350

### Power Window Motor

#### Removal

1. Disconnect the battery ground cable.

2. Remove the door trim panel.
3. Disconnect power window motor wire from wire harness connector (Fig. 10).
4. Check inside the door to ensure electrical wires are not in line with holes to be drilled in the door inner panel. Using a 12.7mm (1/2-inch) diameter drill bit, drill two holes in the door inner panel at the drill dimples located opposite the two unexposed motor drive retainer screws (Fig. 10).
5. Remove the three motor mount retainer screws using two drilled holes and existing larger hole access to screw heads (Fig. 10).
6. Push the motor toward the outside sheet metal to disengage the motor and drive from the regulator gear. After the motor and drive are disengaged, prop the window in full UP position.
7. Remove the motor and drive from inside the door.

#### Installation

1. Install a new motor and drive assembly (Fig. 10). Tighten motor retaining screws to 5.6-9.6 N·m (50-85 in-lb).
2. Install two pieces of Pressure-Sensitive Waterproof Tape D6AZ-19627-A or equivalent body tape (1 inch square) over drilled holes.
3. Connect power window motor wiring. Connect battery ground cable.
4. Remove glass prop and check window operation.
5. Ensure door drain holes are open.
6. Install trim panel.

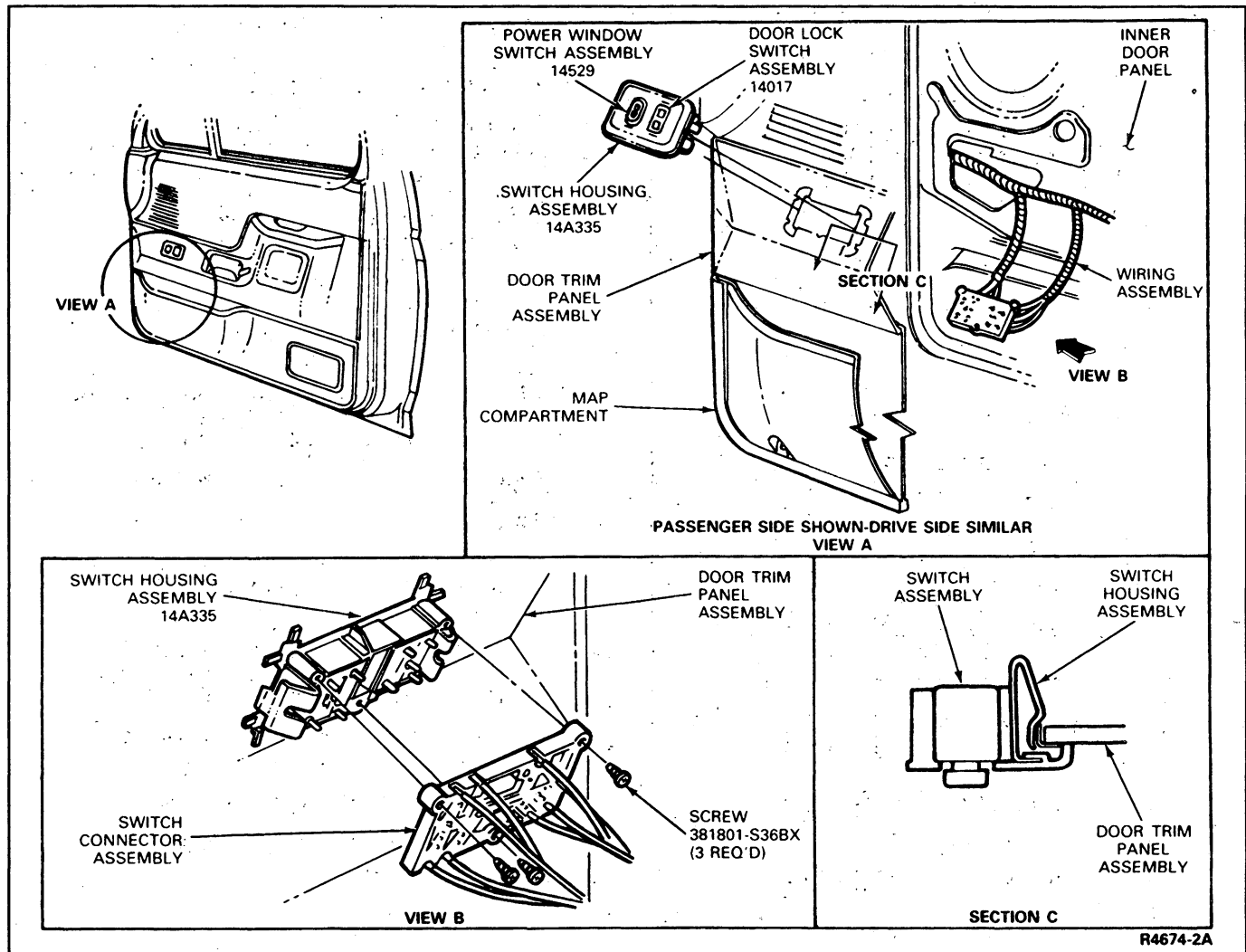


FIG. 8 RH Power Window Switch—F-150, F-250, F-350, F-Super Duty and Bronco

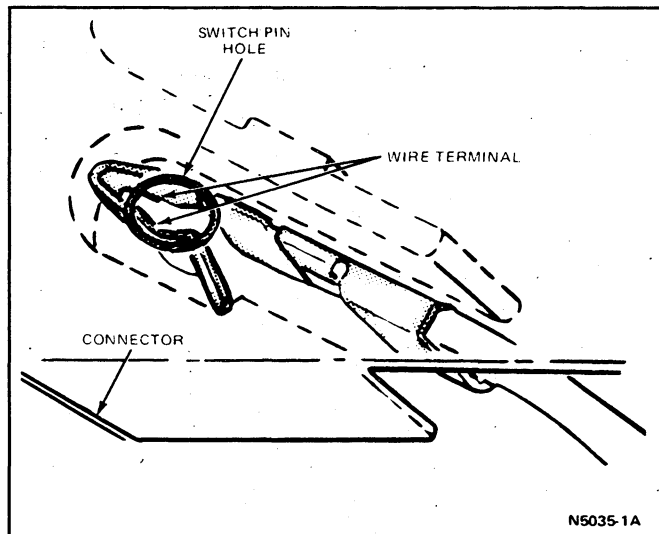


FIG. 9 Power Window Switch Connector Wire Terminal Removal

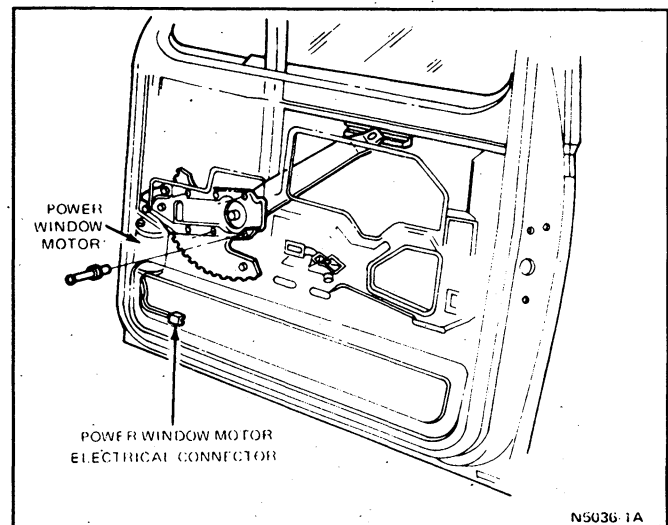


FIG. 10 Power Window Installation—F-Series and Bronco

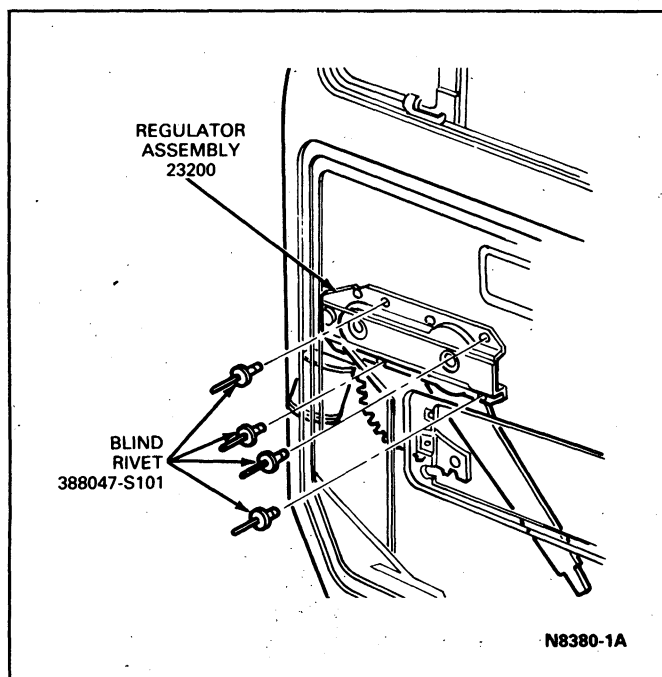


FIG. 11 Power Window Installation—E-Series

## SPECIAL SERVICE TOOLS

### ROTUNDA EQUIPMENT

Model	Description
007-00001	Digital Volt-Ohm Meter

CN6078-1B

# SECTION 42-15 Vent Window Mechanism

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Bronco, F-150—F-350 and F-Super Duty .....	42-15-2	Vent Window Glass .....	42-15-1
Vent Window Assembly and/or Weatherstrip .....	42-15-1	All Models .....	42-15-1
E-150—E-350 .....	42-15-1	<b>SPECIAL SERVICE TOOLS</b> .....	42-15-4
		<b>VEHICLE APPLICATION</b> .....	42-15-1

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350 F-Super Duty and Bronco.

## REMOVAL AND INSTALLATION

### Vent Window Glass

#### All Models

#### Removal

1. Open the vent window.
2. Push the glass from the glass frame using Glass and Channel Removal Tool 2900 or equivalent (Fig. 1).
3. Clean the glass frame of tape and sealer.

#### Installation

1. Apply sealer to the glass frame.
2. Install the glass and new tape in the glass frame using Glass and Channel Removal Tool 2900 or equivalent (Fig. 1).
3. Trim the excess edges of the tape around the glass frame and clean the glass and surrounding area.

### Vent Window Assembly and/or Weatherstrip

#### E-150—E-350

#### Removal

1. Remove the trim panel from the door inner panel. Refer to Section 45-03, Door Trim Panels.

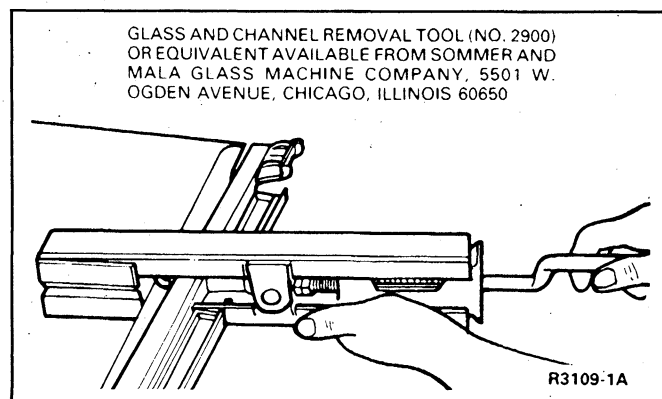


FIG. 1 Vent Glass Replacement

2. Remove three screws attaching the vent window assembly to the upper leading edge of the door (Fig. 2).
3. Remove one screw attaching the division bar bracket to the door (Fig. 2, View B).
4. Lower door glass to the down position.
5. Pull the front run out of the division bar.
6. Tilt the vent window and division bar assembly rearward. Then, remove the vent window and division bar from the door.
7. Remove two screws attaching the vent window upper pivot to the vent window frame.
8. Remove the nut, spring, spacer and bushing from the vent window lower pivot. Then, separate the vent window glass and frame from the vent window frame.
9. To remove the weatherstrip, remove two screws from the top of the vent window frame. Then, straighten the weatherstrip retaining tabs and remove the weatherstrip.

#### Installation

1. Position the weatherstrip to the vent frame.
2. Position the vent window upper pivot to the glass frame pivot and vent frame. Install the two attaching screws.
3. Position the glass frame to the vent frame and install spacer, bushing, spring and nut on the vent window lower pivot. Adjust the spring tension to hold the vent window in any position at highway speeds.
4. Position the vent window and division bar in the door.
5. Position the glass and channel assembly in the front division bar. Then, place the vent window assembly into position in the door. Install three screws attaching the vent frame to the upper leading edge of the door.
6. Insert the rear run into the slot along the top edge of the window opening.
7. Install the screw attaching the division bar bracket to the door.
8. Adjust the window glass runs.
9. Install the trim panel on the door inner panel. Refer to Section 45-03, Door Trim Panels.

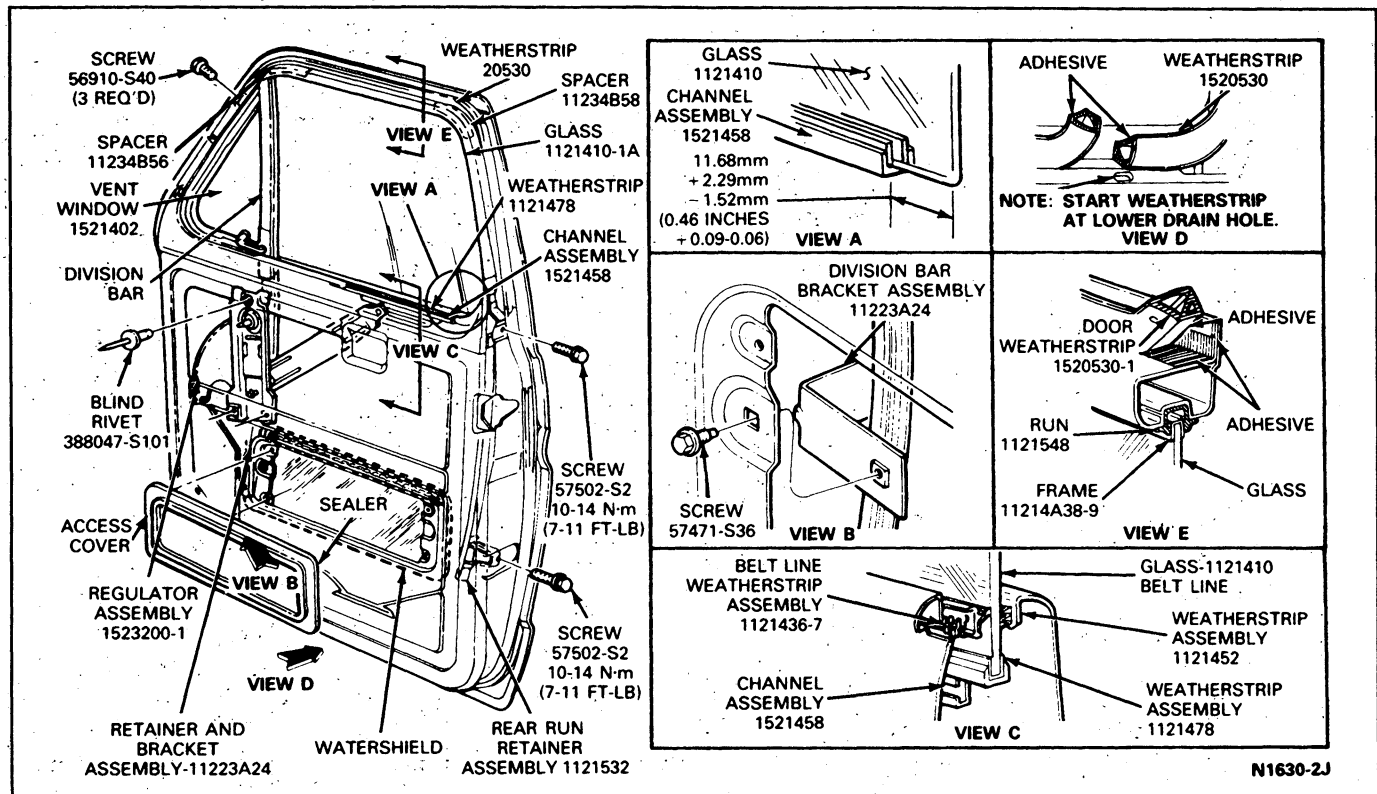


FIG. 2 Front Door Window Glass—E-150—E-350

**Bronco, F-150—F-350 and F-Super Duty****Removal**

1. Remove the door trim panel retaining screws and remove the door trim panel.
2. Remove the screw retaining the division bar to the door inner panel (Fig. 3, Section A).
3. Remove the two screws attaching the vent assembly to the leading edge of the door.
4. Lower the door glass to full down position.
5. Pull the glass run part way out of the door run retainer in the division bar area (Section D).
6. Tilt the vent window and division bar assembly toward the rear of the door and remove the vent window assembly from the door.
7. Remove two vent upper pivot-to-vent frame screws.
8. Remove the retaining nut and tension spring from the vent window lower pivot.
9. Separate the vent glass retainer and the pivot stops from the vent frame and weatherstrip assembly.

**Installation**

1. Position the vent glass retainer assembly with the pivot stops into the vent window frame and weatherstrip assembly.
2. Install the two upper pivot-to-frame retaining screws.
3. Install the pivot tension spring and retaining nut. Adjust spring tension so that the vent will stay open at highway speeds.
4. Position the run assembly in the vent window assembly.
5. Position the vent window and division bar assembly into the door and to the glass edge. Ensure front door window spacer (Fig. 3, View E) is in place.
6. Install the vent window frame to leading edge of door window frame with two retaining screws.
7. Install the division bar screw (adjust the run for proper door window operation).
8. Install the door trim panel.

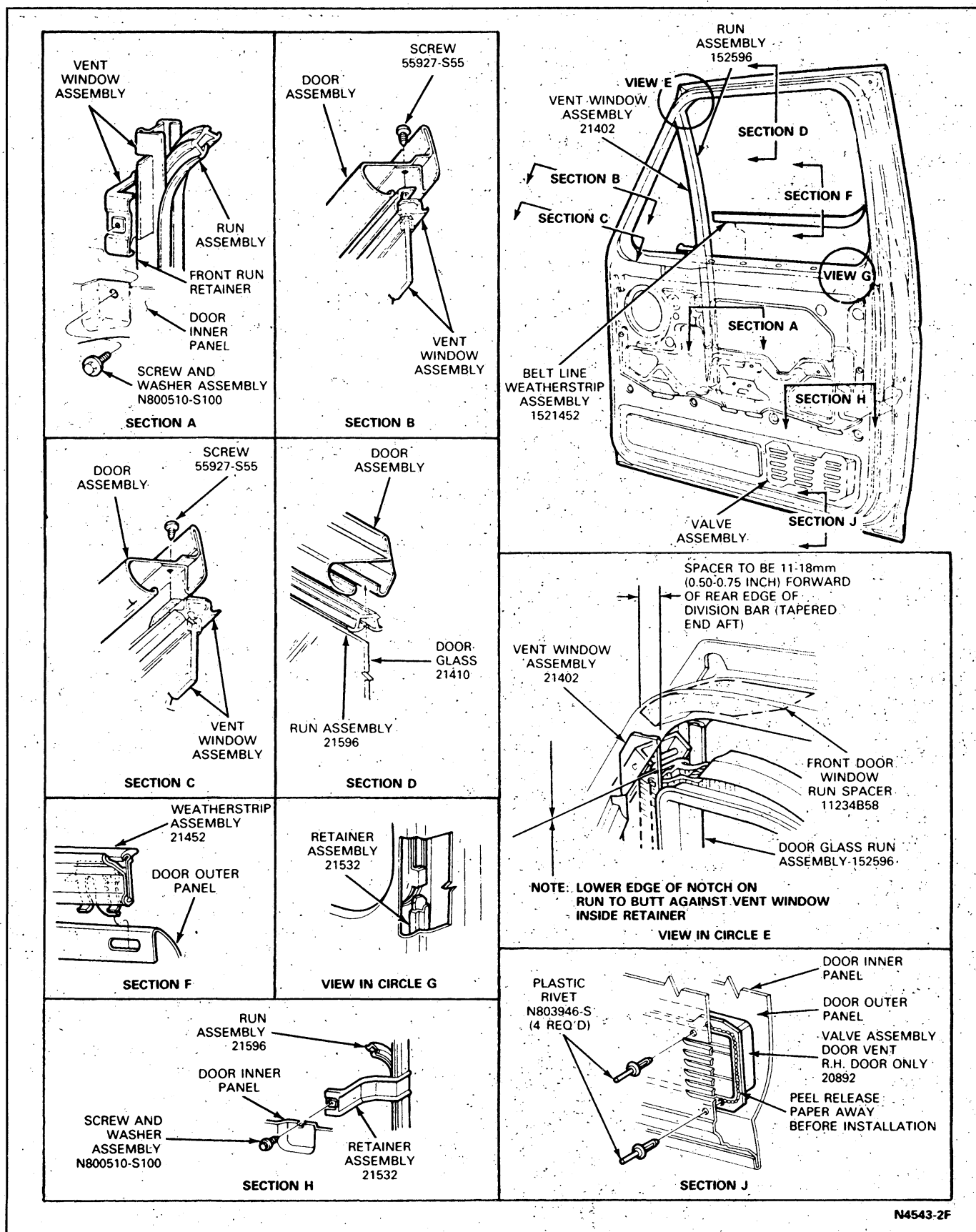


FIG. 3 Front Door Window Glass—F-150—F-350, F-Super Duty and Bronco

**SPECIAL SERVICE TOOLS**

Tool Number	Description
2900	Glass and Channel Removal Tool

CN6016-1A



# SECTION 42-25 Pivot Type Rear Door and Side Window

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>VEHICLE APPLICATION</b> .....	42-25-1
Movable Glass Weatherstrip .....	42-25-1		
E-150—E-350 and Club Wagon .....	42-25-1		
Movable Glass—Door and Body Side— (Back Doors Typical) .....	42-25-1		
E-150—E-350 and Club Wagon .....	42-25-1		

## VEHICLE APPLICATION

E-150 Through E-350.

## REMOVAL AND INSTALLATION

### Movable Glass—Door and Body Side—(Back Doors Typical)

E-150—E-350 and Club Wagon

#### Removal

1. Remove the trim panel, if so equipped, from the door. It is not necessary to remove the LH body side trim panel unless the plate on the body is to be removed.
2. Remove screws attaching the latch assembly and the latch anchor to the door or side inner panel. It is necessary to catch the loose tapping plate when removing the handle screws on the door flip windows (Figs. 1 and 2).
3. Remove glass and latch assembly by rotating it out to disengage the hinge.
4. To remove the hinge from the door or body, remove the four screws.

#### Installation

1. Center the hinge to the body. Tighten the four screws to 0.9-2.25 N·m (8-20 in-lb).

2. Engage the glass and latch assembly into the hinge. Rotate the hinge to a closed position.
3. Position the latch plate to the door or side inner panel. Position the latch anchor inside the door and install the attaching screws. The latch anchor is attached to the body side inner panel when equipped with garnish mouldings (Figs. 1 and 2). Tighten the screws to 3-8 N·m (2-6 ft-lb).
4. Install the door trim panel, if so equipped.

### Movable Glass Weatherstrip

E-150—E-350 and Club Wagon

#### Removal and Installation

1. To remove weatherstrip open the window and pull the weatherstrip from the window opening.
2. Apply Weatherstrip Adhesive C0A2-19552-AA or equivalent to both sides of the window opening flange around the entire perimeter of the opening.
3. Install the weatherstrip onto the window opening flange as shown in Figs. 1 and 2.
4. Apply Ford Silicone Lubricant D7AZ-19553-AA or equivalent to outside surface of weatherstrip along entire top and 10 cm (4 inches) on each side at top.

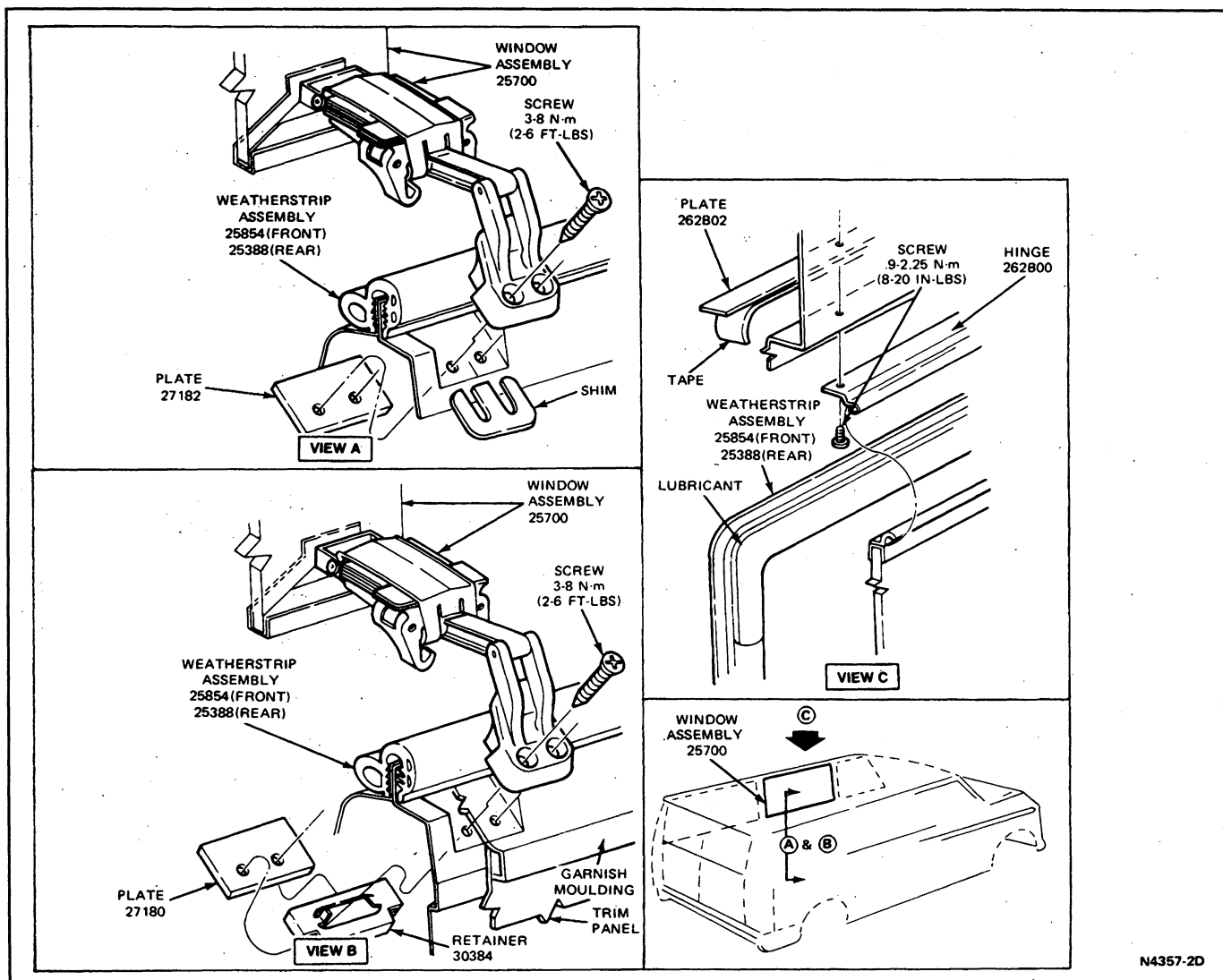


FIG. 1 Body Side Pivot Windows—E-150—E-350, Club Wagon

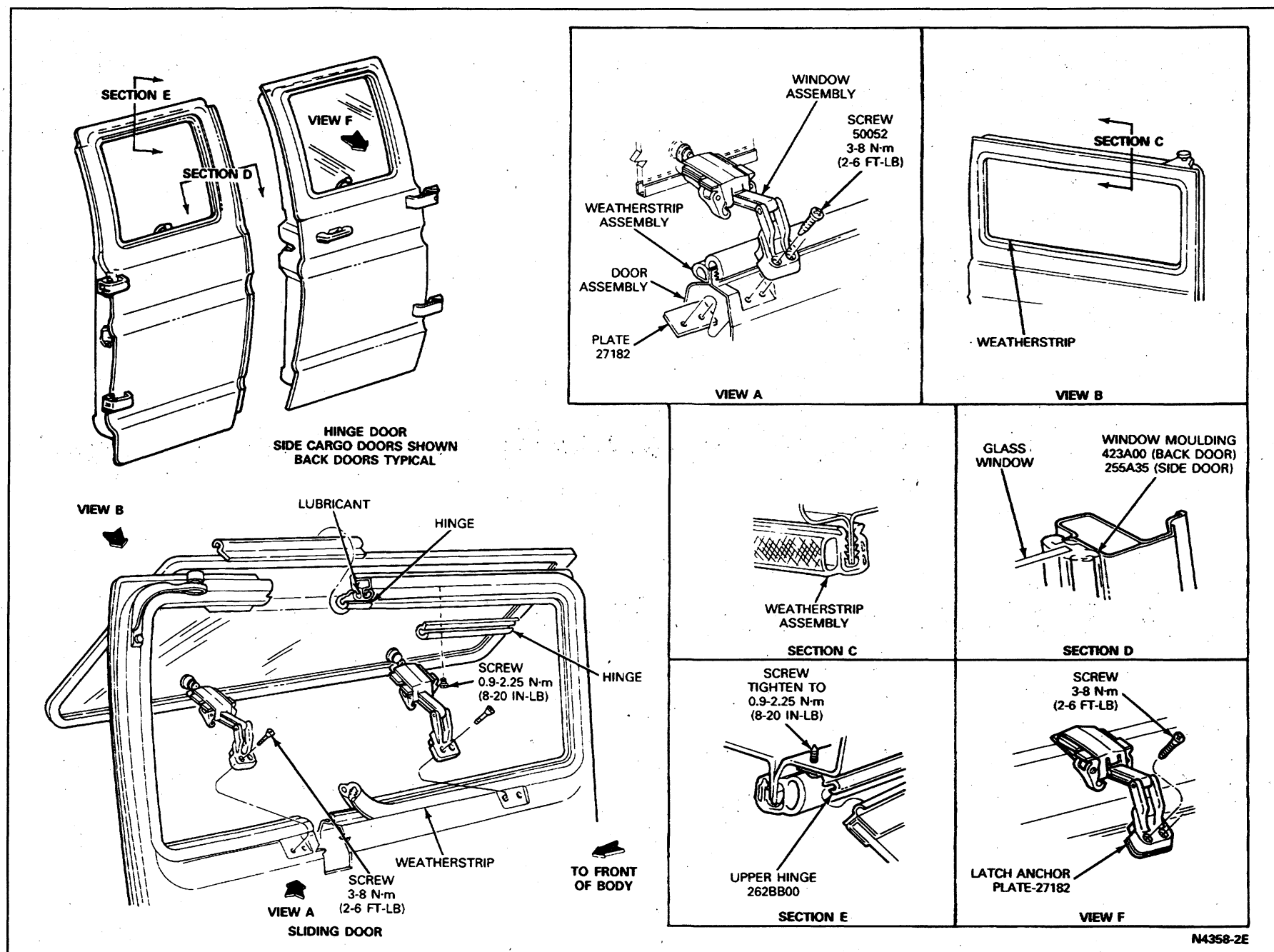


FIG. 2 Sliding Door Pivot Windows—E-150—E-350, Club Wagon

## SECTION 42-30 Rear Door Window Glass and Mechanisms

SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION		VEHICLE APPLICATION .....	42-30-1
Fixed Windows .....	42-30-1		

### VEHICLE APPLICATION

Crew Cab Only.

### REMOVAL AND INSTALLATION

#### Fixed Windows

##### Removal

1. Remove the door latch trim cup, armrest and window regulator handle. Remove door trim panel. Refer to Section 45-03, Door Trim Panels.
2. Remove one screw at top of door and one screw on door inner panel retaining division bar to door (Figs. 1 and 2).
3. With movable window in the down position, remove division bar by pulling it toward rear of vehicle and lifting up, while twisting bar so that the bracket clears the window glass opening and the weatherstrip slides off.
4. Raise movable window half way up, slide the regulator out of the window glass channel, and remove the window from the window opening.
5. Pull fixed window and weatherstrip towards rear of vehicle as an assembly and remove.

##### Installation

1. Install weatherstrip to fixed window (Fig. 3).

2. Position fixed window and weatherstrip as an assembly into the window opening, align in channels, and slide towards front of vehicle until it is firmly seated.
3. Install the movable window into the window opening and while supporting window in half open position, slide window regulator into window glass channel.
4. Install division bar into the window opening.
5. Install movable window weatherstrip into division bar and onto top of movable window.
6. Align movable window into division bar run. Install one screw at top of door and one bolt to front of door to retain division (Figs. 1 and 2) bar. Tighten to specifications.
7. Cycle window and check for looseness or binding. Adjust channel as necessary by loosening rear window run retaining bolt and moving rear window run forward or rearward. Tighten rear window run screw securely as specified.
8. Install door trim panel. Refer to Section 45-03, Door Trim Panels.
9. Install the armrest with two bolts and the door latch trim cup with one screw.
10. Install the window regulator handle with one screw.

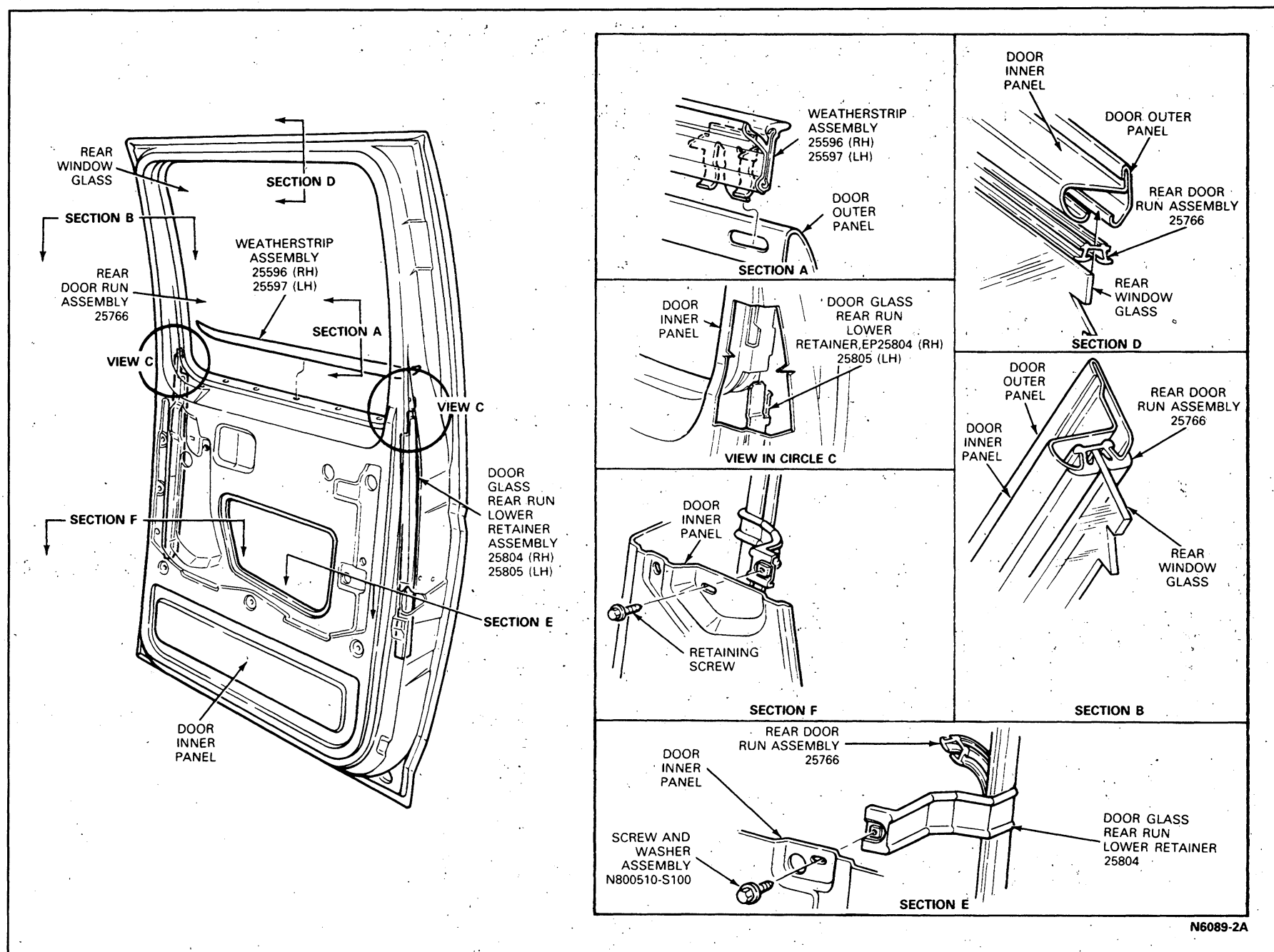


FIG. 1 Crew Cab Rear Door Window, Weatherstrips and Retainers

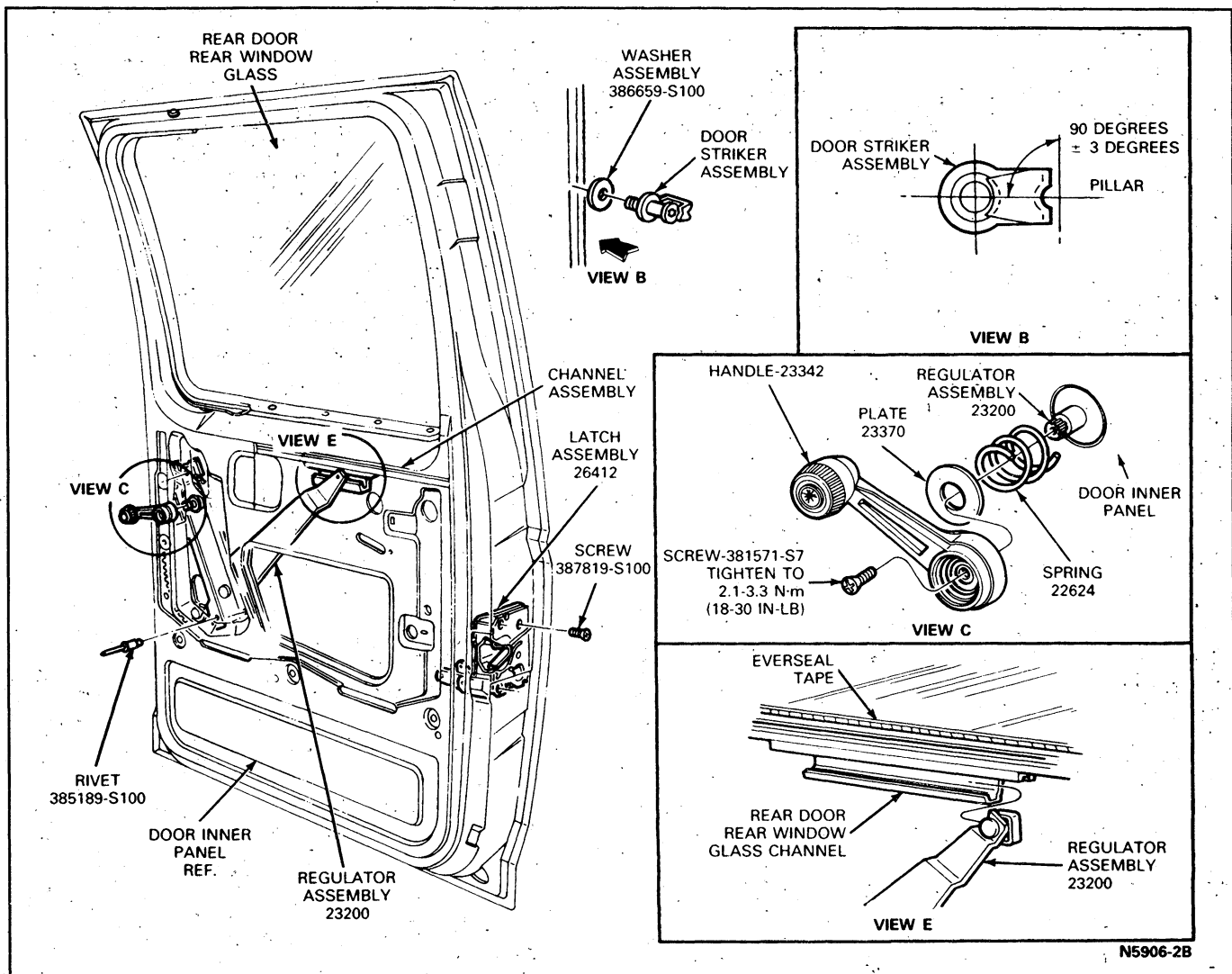


FIG. 2 Crew Cab Rear Door Window Mechanisms

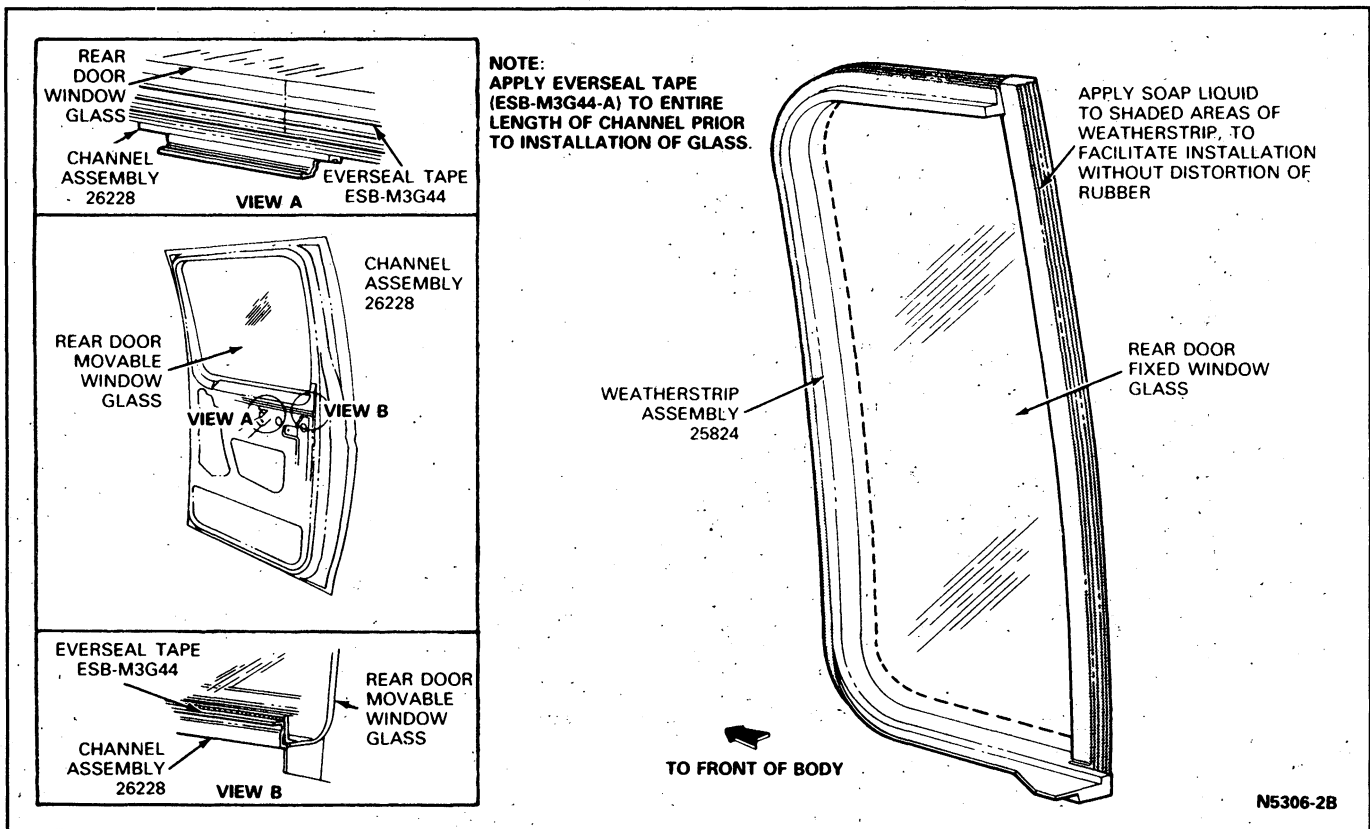


FIG. 3 Crew Cab Rear Door Window Glass

# SECTION 42-35 Tailgate Window Mechanisms

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Tailgate Glass .....	42-35-1	Window Regulator .....	42-35-4
<b>DESCRIPTION</b> .....	42-35-1	<b>SPECIAL SERVICE TOOLS</b> .....	42-35-6
<b>REMOVAL AND INSTALLATION</b>		<b>TESTING</b>	
Glass .....	42-35-2	Tailgate Power Window Motor Test .....	42-35-1
Lock Cylinder .....	42-35-4	Tailgate Window Switch Tests .....	42-35-1
Tailgate Window Regulator Electric		<b>VEHICLE APPLICATION</b> .....	42-35-1
Motor .....	42-35-4		
Tailgate Window Regulator Switch (Tailgate			
Mounted) .....	42-35-4		

## VEHICLE APPLICATION

Bronco.

## DESCRIPTION

The tailgate window regulator is electrically operated by either the key switch located on the tailgate or the switch located on the instrument panel (Fig. 1).

## TESTING

### Tailgate Power Window Motor Test

To test the current draw of a power window motor, remove the tailgate trim panel. Refer to Section 45-03, Door Trim Panels.

#### Test Procedure

1. Disconnect the power window motor lead.
2. Supply power to motor lead connector with an ammeter in series as shown in Fig. 2.
3. Operate the motor and observe the current draw. The current draw for the no-load test should not exceed four amps and should not fluctuate. Reversal of the motor wire connections will reverse the direction of motor rotation. Replace the motor if the current draw exceeds four amps.

**WARNING: COUNTERBALANCE SPRING IS UNDER TENSION! BEFORE REMOVING THE MOTOR TO TEST THE NO-LOAD CURRENT, USE THE CONTROL SWITCH TO MOVE THE REGULATOR UP, THUS REDUCING SPRING TENSION. THEN, LOCK/CLAMP THE SECTOR GEARS SECURELY.**

### Tailgate Window Switch Tests

#### Instrument Panel Mounted

Refer to Fig. 3.

#### Test Procedure

1. Use a self-powered test lamp or an ohmmeter, such as Rotunda Digital Volt-Ohm Meter 007-00001 or equivalent, to test the power tailgate switch.
2. With the switch in the NEUTRAL position, there should be continuity between terminals 1 & 2 and

terminals 3 & 4. Terminal 5 should be disconnected from all other terminals.

3. When the switch rocker knob is pushed up (to close the tailgate window), there should be continuity between terminals 1 & 2 and terminals 4 & 5. Terminal 3 should be disconnected from all other terminals.
4. When the switch rocker knob is pushed down (to open the tailgate window), there should be continuity between terminals 2 & 5 and terminal 3 & 4. Terminal 1 should be disconnected from all other terminals.
5. If the switch assembly does not test as stated, replace the switch.

#### Tailgate Mounted

Refer to Fig. 3.

#### Test Procedure

Testing of the tailgate-mounted window switch can be performed with the switch installed in the vehicle. Use a self-powered test lamp or an ohmmeter.

1. With the switch in the neutral position, there should be continuity between terminals 1, 2 and 3.
2. With the key rotated clockwise (window UP) there should be continuity between terminals 1 and 5, and 2 and 4.
3. With the key rotated counterclockwise (window DOWN) there should be continuity between terminals 2 and 5, and 3 and 4.
4. If the switch does not test as stated, replace the switch.

## ADJUSTMENTS

### Tailgate Glass

Fore-and-aft adjustments can be made after opening the tailgate by loosening the back window side glass run attaching screws (2 per side) (Fig. 4). Adjust the glass as required and tighten the attaching screws to 9-14 N·m (6-11 ft-lb) (Fig. 4).



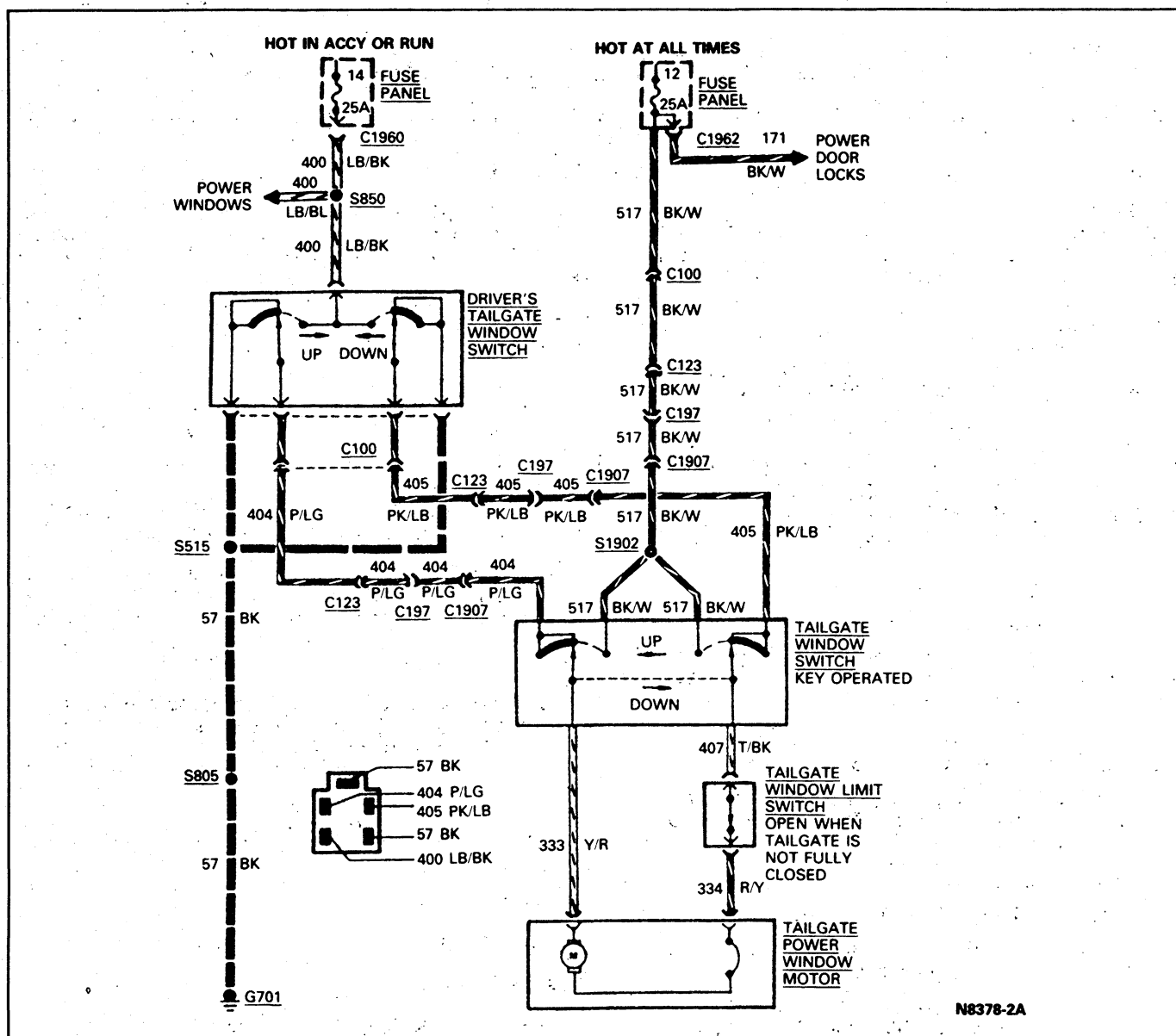


FIG. 1 Tailgate Power Window Electrical Schematic

## REMOVAL AND INSTALLATION

### Glass

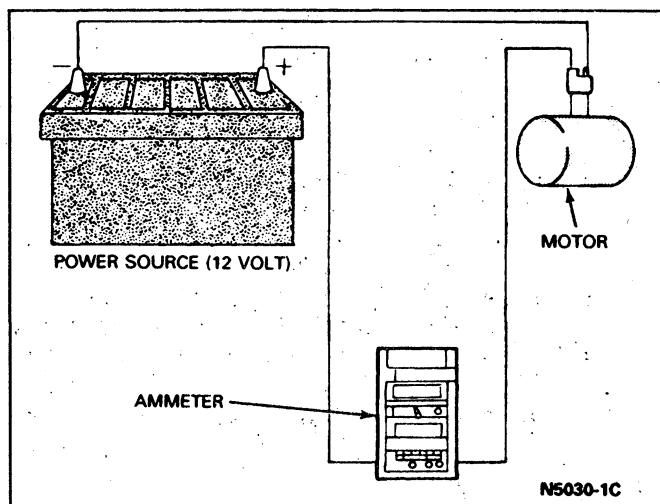
#### Removal

1. Open tailgate.
2. Remove inside cover access panel (10 screws) (Fig. 4).
3. Remove inside cover panel support (1 screw) (Fig. 4).
4. Remove inside cover watershield.
5. Manually close both tailgate latches to raise the glass.
6. Remove four nuts retaining glass and bracket assembly to regulator.
7. If tailgate has heated glass option, disconnect two terminals (drivers side).

8. Grind off four rivets, two on each bracket assembly to glass. Punch out four rivets and remove four retainers and spacers.
9. Pull out tailgate upper corner seal assembly, one on each side.
10. Snap out tailgate inside belt weatherstrip assembly with tool.
11. Slide back window glass out from tailgate assembly.

#### Installation

1. Slide glass midway into tailgate assembly.
2. Connect heated glass wires, if so equipped.
3. Install glass bracket C-channels onto the regulator arm slide guides.
4. Position tailgate glass over glass bracket C-channel studs and install four spacers, retainers and rivets.



**FIG. 2 Power Window Motor Current Draw Test—Permanent Magnet Type Motor**

5. Lower glass to connect heated glass wiring terminals.
6. Close tailgate and cycle glass to ensure smooth operation.
7. Install watershield.
8. Install inside cover panel support (1 screw).
9. Install ten inside cover access panel screws.
10. Close door and cycle tailgate to ensure proper function.

### Tailgate Window Regulator Switch (Instrument Panel Mounted)

NOTE: The tailgate switch is located in the lower LH finish panel on the instrument panel.

#### Removal

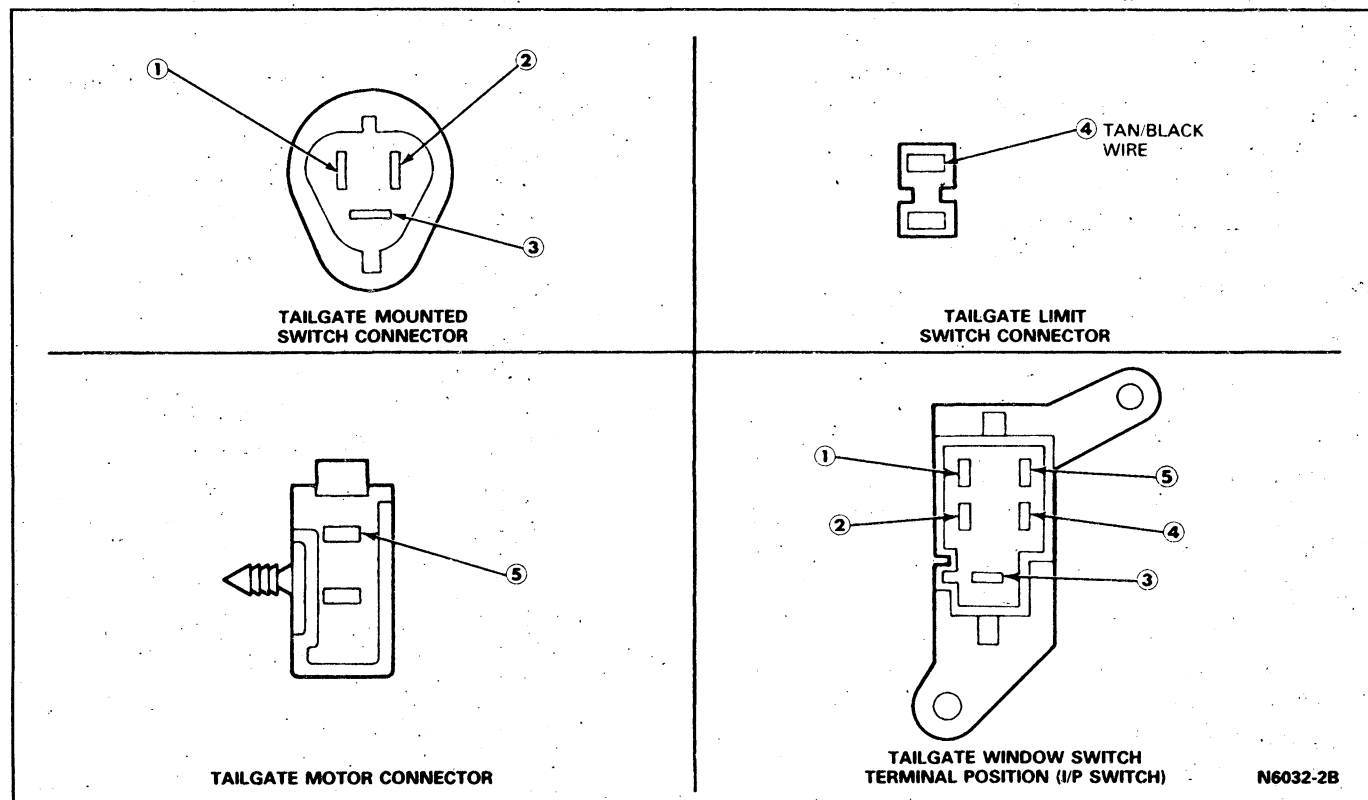
1. Remove the headlamp switch knob and the windshield wiper switch knob by releasing the knob retaining clips and pulling the knobs from their switch shafts.
2. Using a thin-bladed screwdriver (or a small putty knife) carefully pry off the lower left finish panel by starting at the upper left corner of the finish panel and working counterclockwise around the perimeter of the finish panel.

NOTE: The finish panel is held in place by four retaining clips on the instrument panel holding four plastic fingers on the finish panel and care should be taken not to break the four plastic fingers when prying the finish panel off.

3. Remove the two switch retaining screws and remove the switch from the finish panel.
4. Separate the switch assembly from the wiring harness by grasping the wiring harness in one hand (close to the switch), the switch in the other hand and pulling them apart.

#### Installation

1. Position the wiring connector to the switch and push them firmly together.
2. Position the switch to the finish panel and install the two retaining screws.



**FIG. 3 Tailgate Window Terminal Position**

3. Position the finish panel to the instrument panel taking care to align the four plastic fingers with the four retaining clips and press firmly into place.
4. Reinstall the headlamp switch knob and the windshield wiper switch knob.

### **Tailgate Window Regulator Switch (Tailgate Mounted)**

#### **Removal**

1. Remove interior access cover panel.
2. Raise glass. If glass cannot be raised, remove glass as outlined.
3. Disconnect wiring harness.
4. Detach switch from lock cylinder by removing clip and remove from tailgate (Fig. 4).

#### **Installation**

1. Install switch on lock cylinder and install clip (Fig. 4).
2. Connect wiring harness.
3. Check operation of switch.
4. Install interior access cover panel.

### **Tailgate Window Regulator Electric Motor**

#### **Removal**

Refer to Window Regulator Removal.

1. Raise glass to full up position. If glass cannot be raised, remove glass as outlined.
2. Disconnect motor wiring harness (Fig. 4).

**WARNING: COUNTERBALANCE SPRING IS UNDER TENSION! TO PREVENT INJURY FROM SUDDEN MOVEMENT OF REGULATOR COMPONENTS, CLAMP/LOCK GEAR SECTORS TO ALLOW SAFE MOTOR REMOVAL.**

3. Detach and remove electric motor from tailgate.

#### **Installation**

1. Position electric motor in tailgate and secure to regulator (Fig. 4).
2. Connect wiring harness.

3. Check operation of electric motor.
4. Install interior access cover.

### **Window Regulator**

#### **Removal**

1. Lower tailgate and remove interior access cover panel (10 screws). If tailgate will not lower because glass will not go full down, manually depress safety lockout rod (located in bottom center of tailgate).
2. Raise glass using jumper to motor (or manually close L.H. tailgate latch) (Refer to Fig. 1). If the glass will not go up, glass must be removed as outlined.
3. Remove regulator attaching screw and washer assemblies.
4. Remove regulator.

#### **Installation**

1. Position regulator in tailgate and secure with four screw and washer assemblies (Fig. 4). Tighten to 9-14 N·m (6-11 ft-lb).
2. Install glass as outlined.
3. Check operation of regulator.
4. Install interior access cover panel.

### **Lock Cylinder**

#### **Removal**

1. Remove interior access cover panel.
2. Raise glass. If glass cannot be raised, remove glass as outlined.
3. Remove lock cylinder retainer (Fig. 4).
4. Disengage lock cylinder from switch and remove from tailgate.

#### **Installation**

1. Position lock cylinder to tailgate and engage in switch.
2. Secure lock cylinder with retainer.
3. Check operation of lock cylinder and switch.
4. Install interior access cover panel.

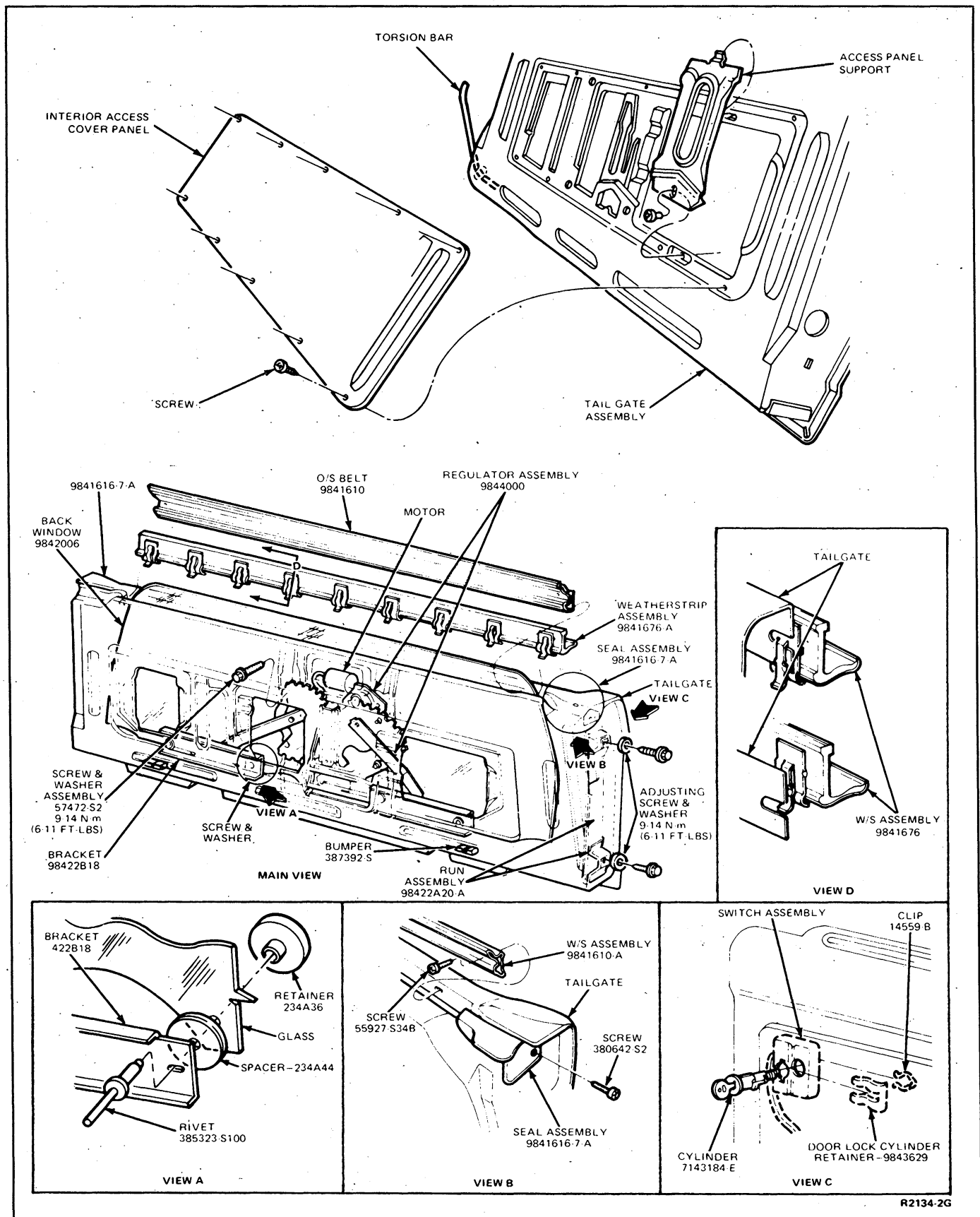


FIG. 4 Tailgate Window Mechanism and Belt Weatherstrips—Bronco

**SPECIAL SERVICE TOOLS****ROTUNDA EQUIPMENT**

Model	Description
007-00001	Digital Volt-Ohm Meter

CN6078-1B

# STATIONARY WINDOW GLASS

## GROUP 43

(70000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
STATIONARY GLASS—BUTYL—TYPE SEAL .....	43-11-1	STATIONARY GLASS—WEATHERSTRIP TYPE SEAL .....	43-01-1

## SECTION 43-01 Stationary Glass—Weatherstrip Type Seal

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Back Window .....	43-01-1	Rear Side Window Glass .....	43-01-2
F-150—F-350, F-Super Duty .....	43-01-1	Bronco .....	43-01-2
Body Side and Rear Window Glass .....	43-01-2	F-150—F-350 Super Cab .....	43-01-2
E-150—E-350 .....	43-01-2	<b>VEHICLE APPLICATION</b> .....	43-01-1
Movable Back Window .....	43-01-4		
F-150—F-350 and F-Super Duty .....	43-01-4		

### VEHICLE APPLICATION

E-150—E-350, F-150—F-350, F-Super Duty and Bronco.

### REMOVAL AND INSTALLATION

#### Back Window

#### F-150—F-350, F-Super Duty

An assistant outside the vehicle is necessary when removing or replacing the glass.

#### Removal

Refer to Fig. 1.

1. From the interior of the vehicle, pull down the weatherstrip. Push the back window glass and weatherstrip out of the window opening from inside the cab while an assistant grasps the window from outside the cab.
2. Remove the weatherstrip from the glass. Clean all sealer from the weatherstrip and/or glass, if either is to be reused.
3. Clean all sealer from the back window opening.

### Installation

1. Install the outside moulding, if so equipped. Position the weatherstrip to the back window glass.
2. Install a draw cord all around the weatherstrip in the flange crevice (Fig. 2), allowing the cord to overlap at the bottom center of the glass. Coat the weatherstrip mounting surface with Rubber Lubricant D9AZ-19583-A or equivalent.
3. Apply Liquid Butyl Sealer C9AZ-19554-B or equivalent to the back window opening as shown in Fig. 1.
4. Position the glass and weatherstrip to the window opening. With an assistant applying hand pressure from outside the cab, pull (from inside) the weatherstrip lip over the window opening flange with the draw cord. Pull the weatherstrip over the lower flange, pulling one end of the cord at a time. Then, pull the weatherstrip over the side flanges and upper flange.
5. Clean the glass and the area around the window to remove all excess sealer.
6. Test for water leaks.

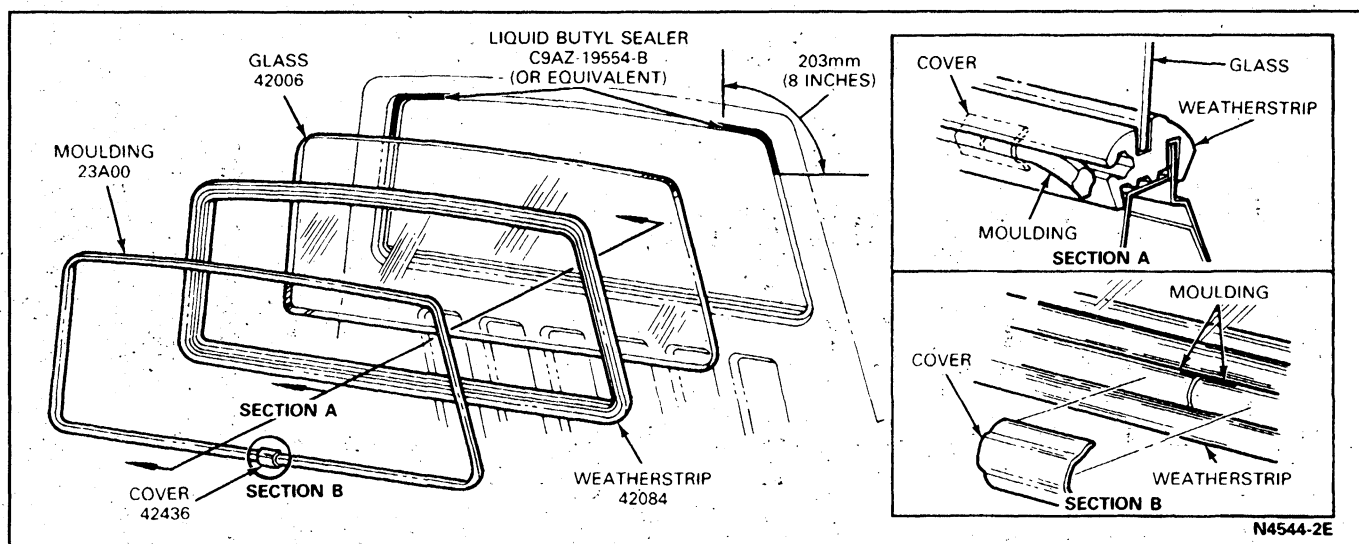


FIG. 1 Stationary Back Window Installation—F-150—F-350 and F-Super Duty

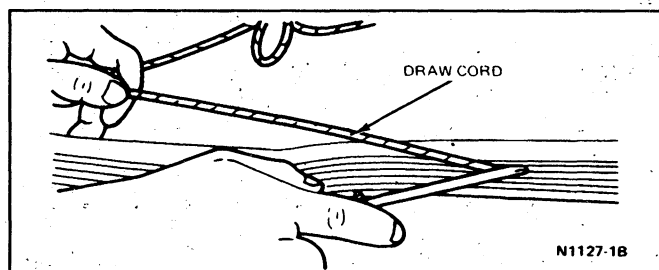


FIG. 2 Draw Cord Installation—Typical

### Rear Side Window Glass

Refer to Fig. 3.

#### Bronco

An assistant outside the vehicle is necessary when removing or replacing the glass.

#### Removal

1. Working from inside, start at one corner and work across the top of the glass, pulling the weatherstrip down and pushing the glass and weatherstrip outward until the assistant can grasp the glass and lift it from the glass opening.
2. Remove the weatherstrip from the glass (Fig. 3).

#### Installation

1. Clean the weatherstrip with cleaning solvent to remove all old sealer and cement.
2. Clean the glass opening flange. Check the flange for wavy areas, and repair as necessary.
3. Apply Liquid Butyl Sealer C9AZ-19554-B or equivalent in the glass crevice of the weatherstrip. Install it on the glass.
4. Apply a bead of Liquid Butyl Sealer C9AZ-19554-B or equivalent between the secondary sealing fins of the weatherstrip (Fig. 3).
5. Install a draw cord all around the weatherstrip in the flange crevice (Fig. 2). Let the draw cord overlap at the bottom center approximately 457mm (18 inches) and tape the ends of the draw cord to the inside of the glass. Apply Rubber Lubricant

D9AZ-19583-A or equivalent to the weatherstrip lip.

6. Have an assistant position the window assembly in the window opening and apply hand pressure on the glass from the outside. From the inside, draw the lip of the weatherstrip over the window opening lower flange with a draw cord. Alternate from side to side, moving approximately 305mm (12 inches) at a time, until the window is in place.
7. Water test the installation for leaks, and seal with additional Liquid Butyl Sealer C9AZ-19554-B or equivalent, if necessary.

#### Quarter Window

##### F-150—F-350 Super Cab

#### Removal

1. Remove interior rear quarter trim panel. Refer to Section 45-11, Quarter Trim Panels.
2. Remove nuts securing moulding assembly (Fig. 4).
3. Remove window assembly and seal.

#### Installation

1. Position window assembly and seal to vehicle.
2. Install nuts securing moulding assembly (Fig. 4).
3. Install interior rear quarter trim panel. Refer to Section 45-11, Quarter Trim Panels.
4. Test for water leaks.

### Body Side and Rear Window Glass

##### E-150—E-350

#### Removal and Installation

NOTE: Mouldings can be installed on the bench prior to window installation.

1. Loosen the weatherstrip around the inside and outside of the window opening (Fig. 5).
2. From the inside of the vehicle, push the glass and weatherstrip from the window opening.
3. Remove the weatherstrip from the glass.
4. Clean the weatherstrip and body opening to remove all old sealer.

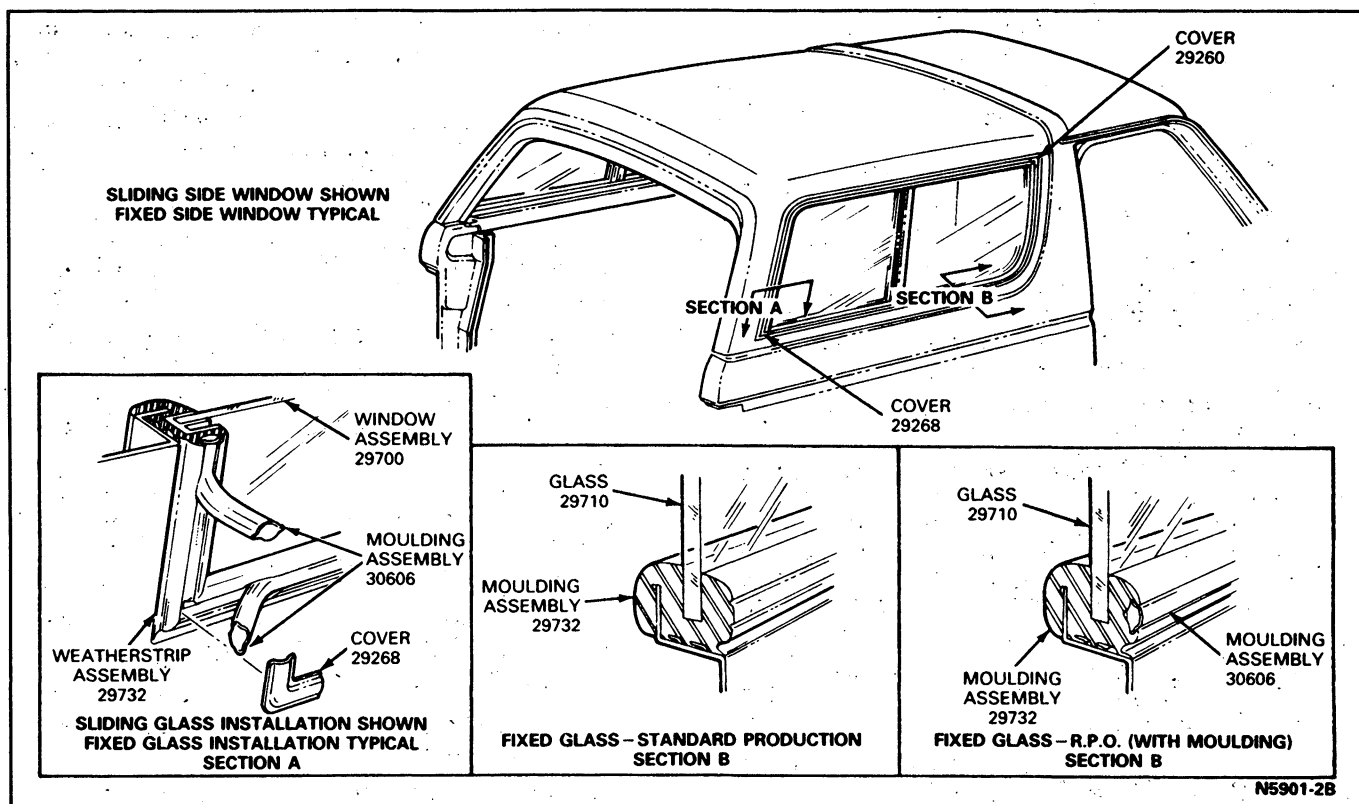


FIG. 3 Rear Side Window Installation—Bronco

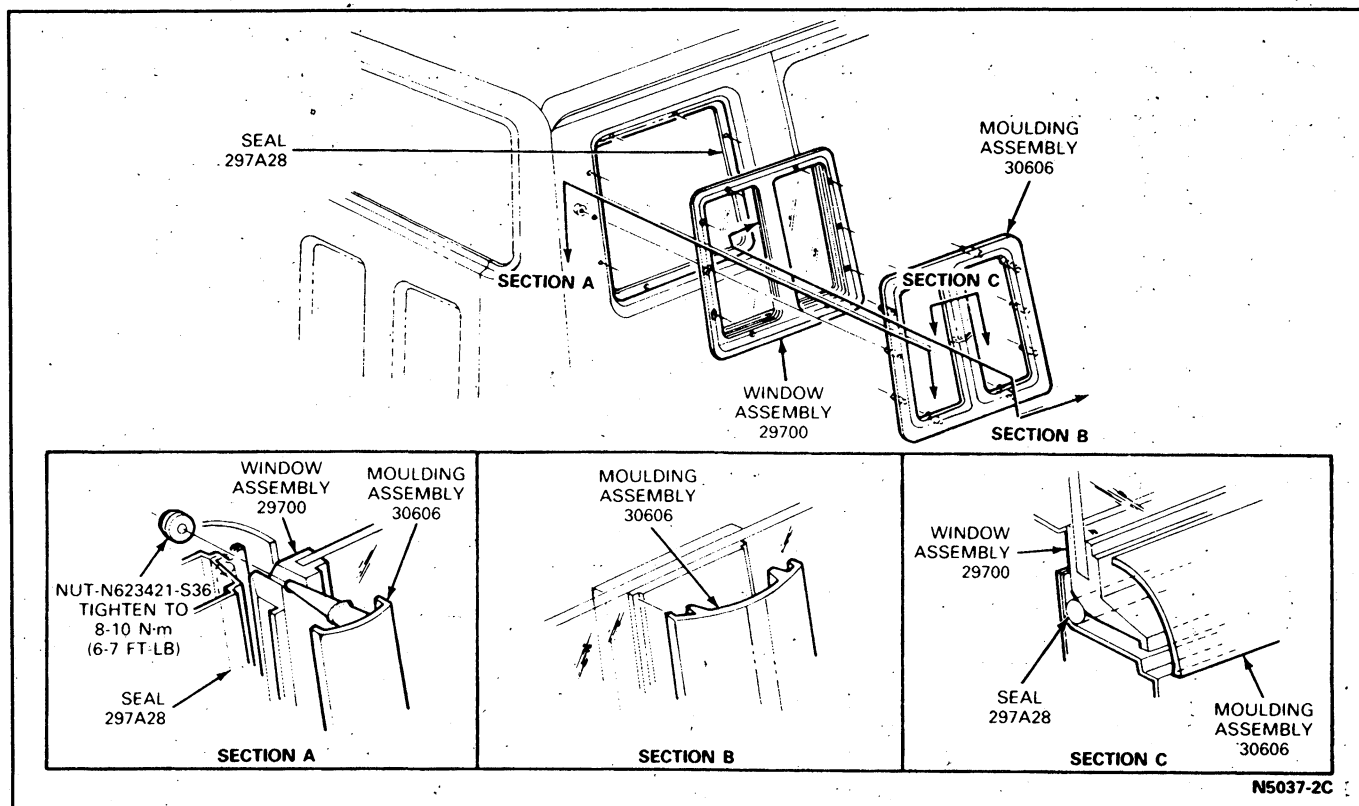


FIG. 4 Quarter Window Installation—F-150—F-350 Super Cab



5. Apply Liquid Butyl Sealer C9AZ-19554-B or equivalent in the glass groove of the weatherstrip (Fig. 5).
  6. Apply Liquid Butyl Sealer C9AZ-19554-B or equivalent around the entire perimeter of the window opening.
  7. Position the weatherstrip to the window glass with butt joint along bottom edge of glass at center of window opening. Install a draw cord in the pinch weld opening of the weatherstrip (Fig. 2). Overlap the cord approximately 457mm (18 inches) at the lower center of the glass and tape the ends of the cord to the inside of the glass.
  8. Position the window glass and weatherstrip to the body opening.
  9. With an assistant applying hand pressure from the outside, pull the draw cord to pull the lip of the weatherstrip over the window opening flange. Draw the weatherstrip over the lower flange, each side flange, and then over the upper flange. Alternate from side to side, moving approximately 305mm (12 inches) at a time, until the window is in place.
  10. Clean the glass, weatherstrip, and surrounding area to remove all excess sealer.
  11. Test for water leaks.
2. Remove the weatherstrip from the window frame and place the movable windows in the open position.
  3. From the top of the window frame, remove the screw retaining each division bar. Also, remove the two screws retaining the anchor plate in the window track and remove the plate.
  4. Spread the window frame and work the movable glass out of its track. Remove it from the frame.
  5. If the stationary glass is to be replaced, remove the division bar, lower retaining screw and remove the division bar.
  6. Spread the window frame just enough to permit the stationary glass to be worked out of the frame.

#### Installation

1. If the stationary glass is to be replaced, apply Silicone Lubricant C0AZ-19553-AA or equivalent to the window weatherstrip and track. Spread the frame slightly and slide the glass into place, in the frame. Do not allow the weatherstrip to bunch.
2. Position the division bar in the frame and install the lower retaining screw.
3. Spread the frame slightly and install the movable glass in its track.
4. Position the anchor plate in the window track and install the two retaining screws.
5. Install the division bar upper retaining screws.
6. Position the weatherstrip to the window frame.
7. Install a draw cord all around the weatherstrip in the flange crevice (Fig. 2), allowing the cord to overlap at the bottom center of the glass.

#### Movable Back Window

#### F-150—F-350 and F-Super Duty

##### Removal

1. From the interior of the vehicle, pull down the weatherstrip lip along the window opening. Push the back window frame and weatherstrip out of the window opening from inside the cab (Fig. 6).

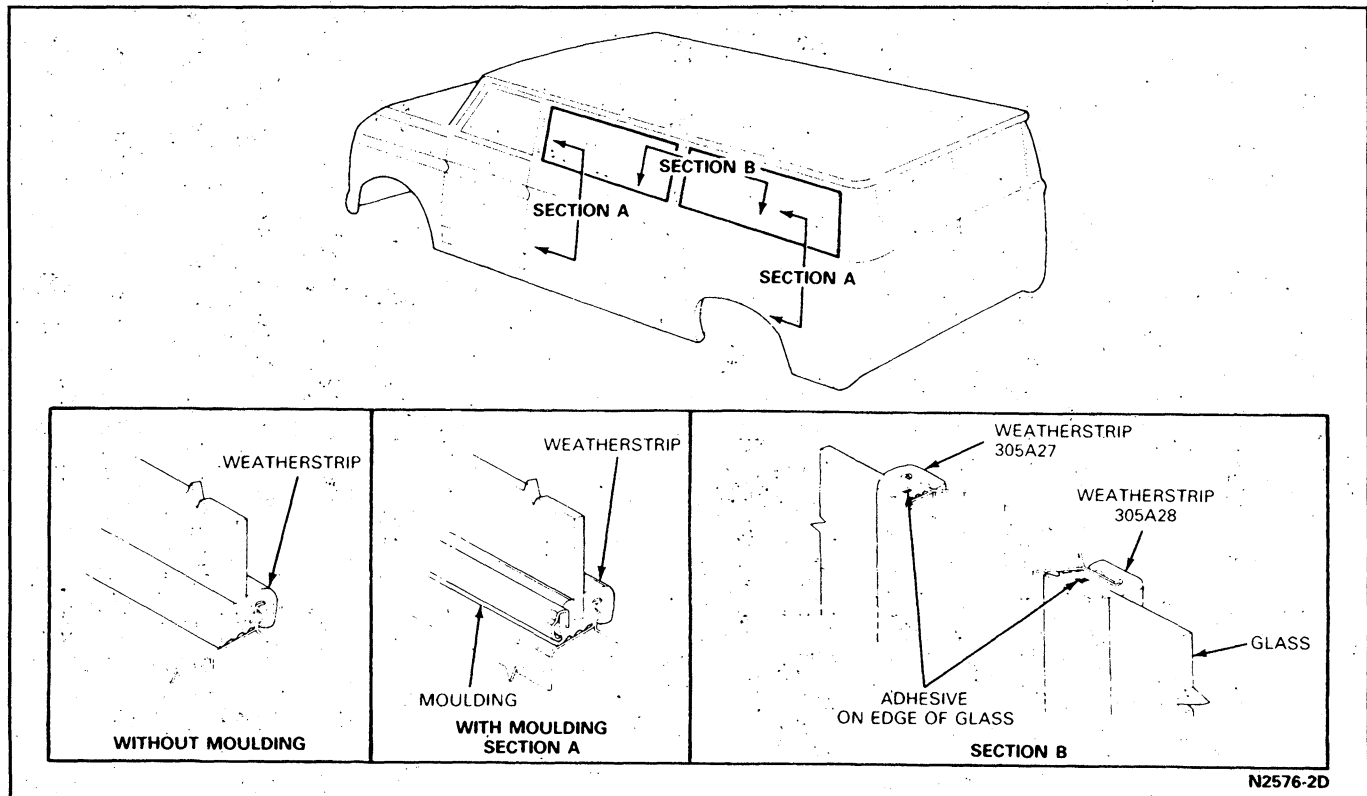
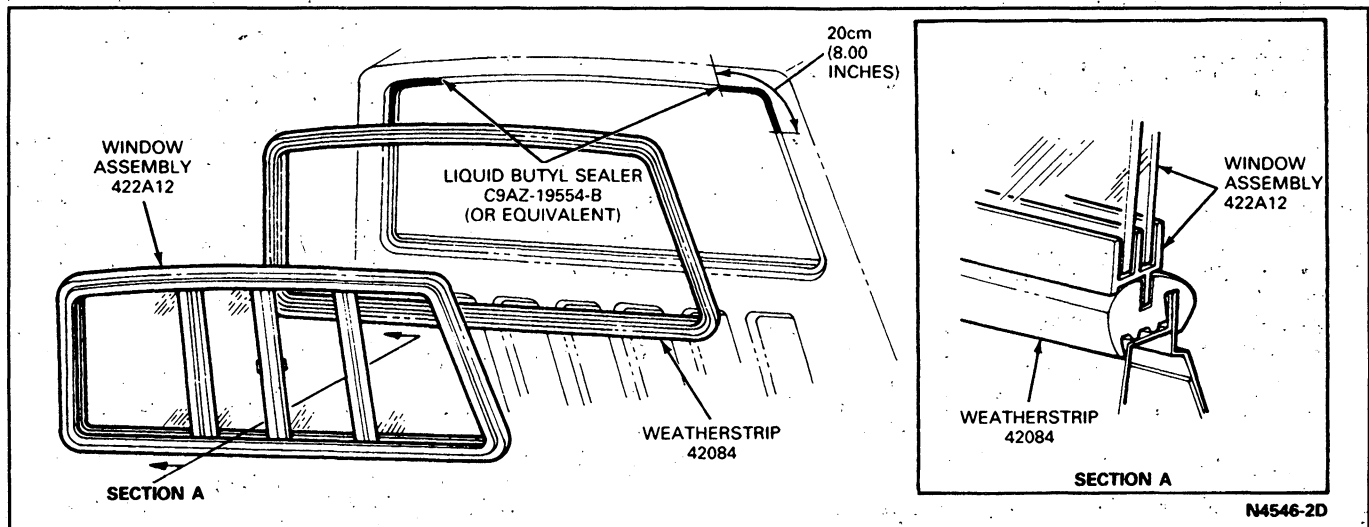


FIG. 5 Body Side and Rear Stationary Window Installation—E-150—E-350



**FIG. 6 Movable Back Window—F-150—F-350 and F-Super Duty**

8. Apply 203mm (8 inches) of Liquid Butyl Sealer C9AZ-19554-B or equivalent between the two secondary sealing fins centered on each upper corner as shown in Fig. 6.
9. Position the glass and weatherstrip to the window opening. With an assistant applying hand pressure

from outside the cab, pull the weatherstrip lip over the window opening flange with a draw cord. Pull the weatherstrip over the lower flange, pulling one end of the cord at a time. Then, pull the seal over the side flanges and upper flange.

# SECTION 43-11 Stationary Glass—Butyl—Type Seal

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION .....	43-11-1	REMOVAL AND INSTALLATION (Cont'd)	
REMOVAL AND INSTALLATION		Windshield .....	43-11-1
Side Window .....	43-11-5	(Procedure No. 1) .....	43-11-1
F-150—F-350 Super Cab .....	43-11-5	(Procedure No. 2) .....	43-11-2
Sealing Leaks .....	43-11-5	VEHICLE APPLICATION .....	43-11-1

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350, F-Super Duty and Bronco.

## DESCRIPTION

There are two applicable procedures for installation of glass with butyl-type seal.

Procedure No. 1 should be used with Windshield and Backlight Seal Kit D9AZ-19562-B or equivalent, packaged with 8mm (5/16-inch) diameter butyl (round type). DO NOT use this kit if adhesion of existing butyl-to-pinch weld flange is unreliable, as indicated by a surface which is not smooth and free of excessive skips, bumps and contamination.

Procedure No. 2 should be used with Windshield and Backlight Seal Kit D9AZ-19562-A or equivalent, packaged with "I" beam-type butyl, where complete replacement of existing butyl is necessary.

## REMOVAL AND INSTALLATION

### Windshield

#### (Procedure No. 1)

##### Removal

1. Remove the windshield wiper arms and blades.
2. Remove the windshield exterior mouldings (Figs. 1 through 5).
3. With Electric Knife T70P-42006-A or equivalent, insert the blade under the edge of the glass (Fig. 6).
4. Cut the butyl seal as close to the inside surface of the glass as possible.
5. To cut the butyl at corners of the windshield, move the handle of the tool as close to the corner of the windshield as possible. Then, rotate the blade downward to cut the corner butyl seal.
6. Remove the glass from the vehicle using Glass Holding Tool D81T-33610-H or equivalent (Figs. 6, 7 and 8).
7. Temporarily position the replacement glass in the windshield opening using spacers to prevent glass-to-metal contact.
8. Adjust glass side-to-side to the best glass-to-A-pillar weld flange overlap position.
9. Adjust the lower spacers, if necessary, for proper positioning at the top. A minimum of 4.8mm (3/16-inch) butyl tape-to-glass contact is required around

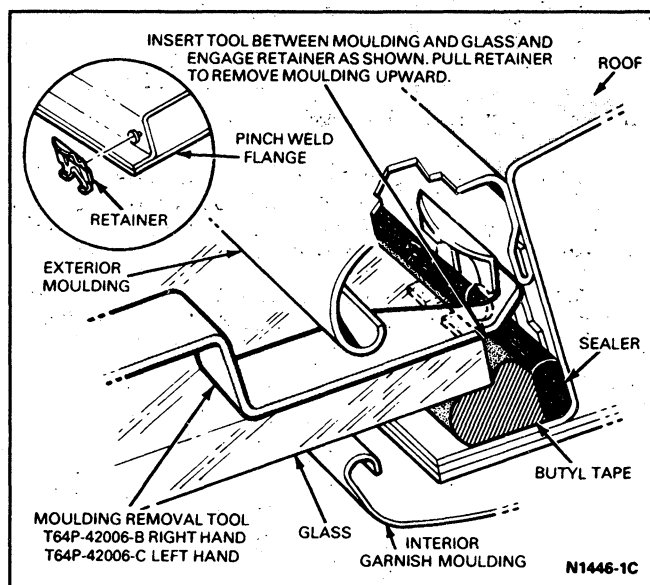


FIG. 1 Windshield Moulding Removal Tool—Typical

the perimeter to ensure proper retention and a waterproof seal. Mark this location on the outside surface of the glass and a corresponding surface of the glass opening.

10. Remove the glass. Clean the inside surface and edge thoroughly.

##### Installation

1. Start at the side of the glass opposite the original butyl splice and place the 8mm (5/16-inch) diameter butyl furnished in the kit on top of and in a position that ensures the 4.8mm (3/16-inch) minimum contact with the glass on the existing butyl remaining on the pinch weld flange (Fig. 9).  
NOTE: Do not allow the new butyl to overhang the edge of the existing butyl. Do not stretch the butyl or bridge the corners of the windshield opening.
2. Carefully splice the two loose ends of the new butyl. The cut line of the splice must taper downward toward the outboard side of the vehicle.
3. Apply the primer (furnished in the kit) around the perimeter of the cleaned inside surface and the edge of the glass in the area that will contact the butyl seal. Allow the primer to dry a minimum of five minutes before installing the glass.
4. Place the glass in the opening, aligning the crayon marks.

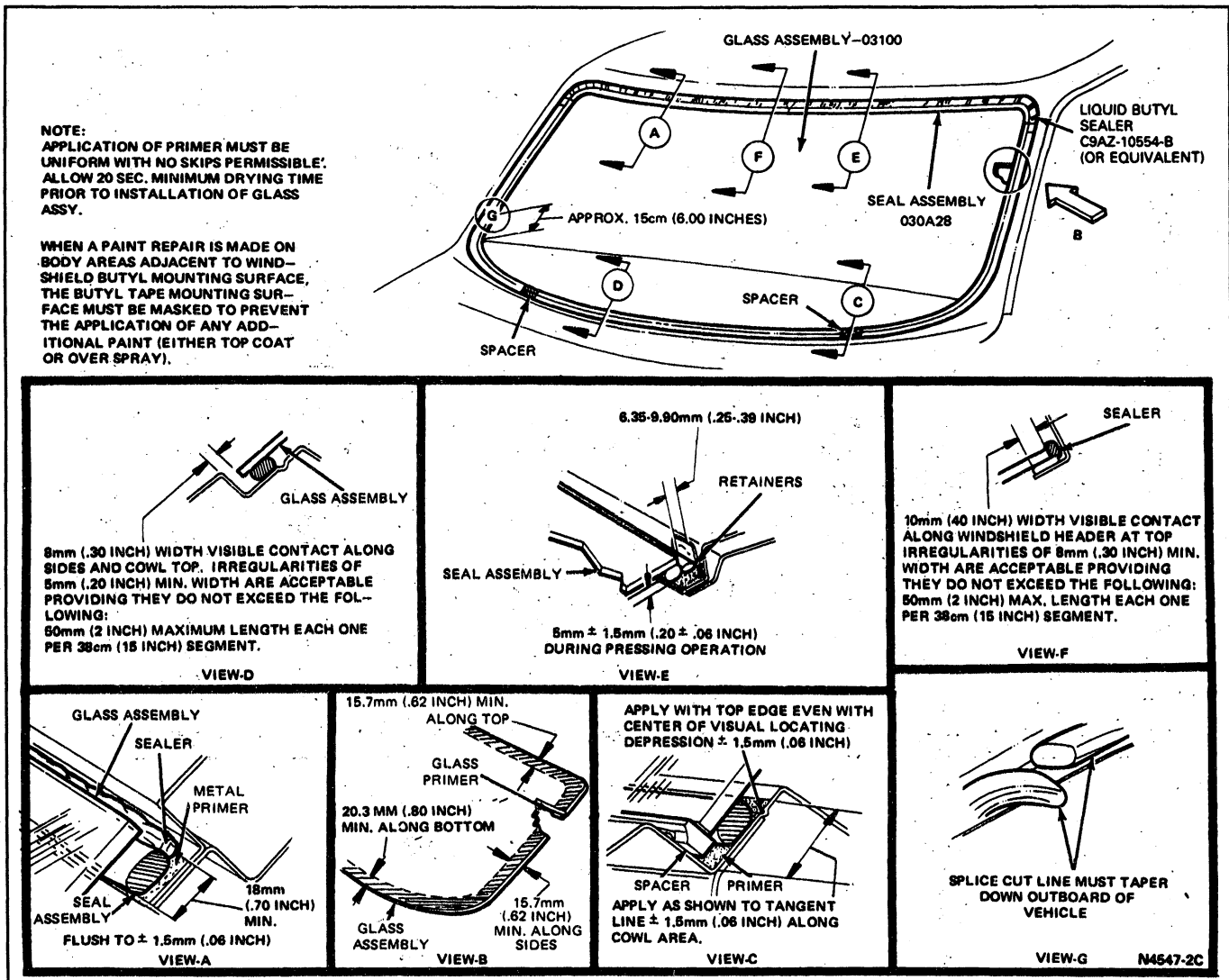


FIG. 2 Windshield Sealers—E-150—E-350

5. Firmly press the glass against the butyl with hand pressure or weights (approximately 113 kg (250 lb)). Verify the 4.8mm (3/16-inch) contact between glass and butyl is achieved. A dull spot indicates an area where the butyl is not contacting the glass surface. Additional pressure should seal such areas.
6. From outside the vehicle, apply Liquid Butyl Sealer C9AZ-19554-B or equivalent around the entire edge of the glass.
7. Remove any excess primer from the inside surface of the glass with a razor blade. Wipe the glass with a clean cloth dampened with naphtha.

**CAUTION: Do not use razor blade to clean primer from heated rear windows. Use of razor blades, steel wool, or abrasive powders will damage the grid wires.**

8. When the liquid sealer has skinned-over (approximately 10 minutes), water test the installation. If necessary, repair any leaks with additional liquid sealer.
9. Install the mouldings and wiper arms and blades.
10. Clean the glass and surrounding areas.

### (Procedure No. 2)

#### Removal

Use the following procedure if adhesion of existing butyl is unreliable:

1. Remove the windshield wiper arms and blades.
2. Remove the windshield exterior mouldings (Figs. 1 through 5). Refer to Group 47—Body Shell, Exterior Trim, Frame and Underbody. On vehicles with heated rear windows, disconnect heating wires before proceeding with glass removal.
3. With Electric Knife T70P-42006-A or equivalent, insert the blade under the edge of the glass (Fig. 6).
4. Cut the butyl seal as close to the inside surface of the glass as possible.
5. To cut the butyl at corners of the windshield, move the handle of the tool as close to the corner of the windshield as possible. Then, rotate the blade downward to cut the corner butyl seal.
6. Remove the glass from the vehicle using Glass Holding Tool D81T-33610-H or equivalent (Figs. 6, 7, and 8).

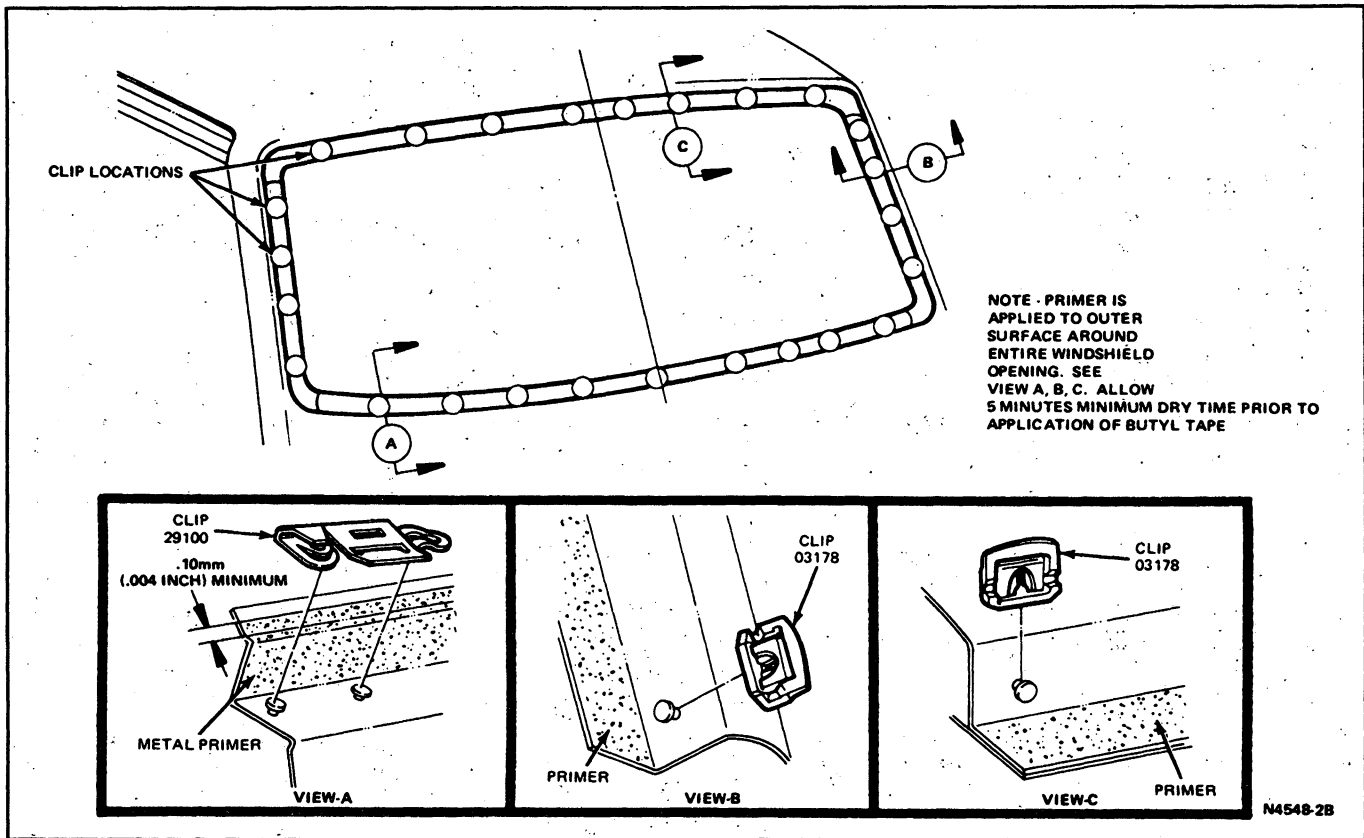


FIG. 3 Windshield Sealers—F-150—F-350, F-Super Duty and Bronco

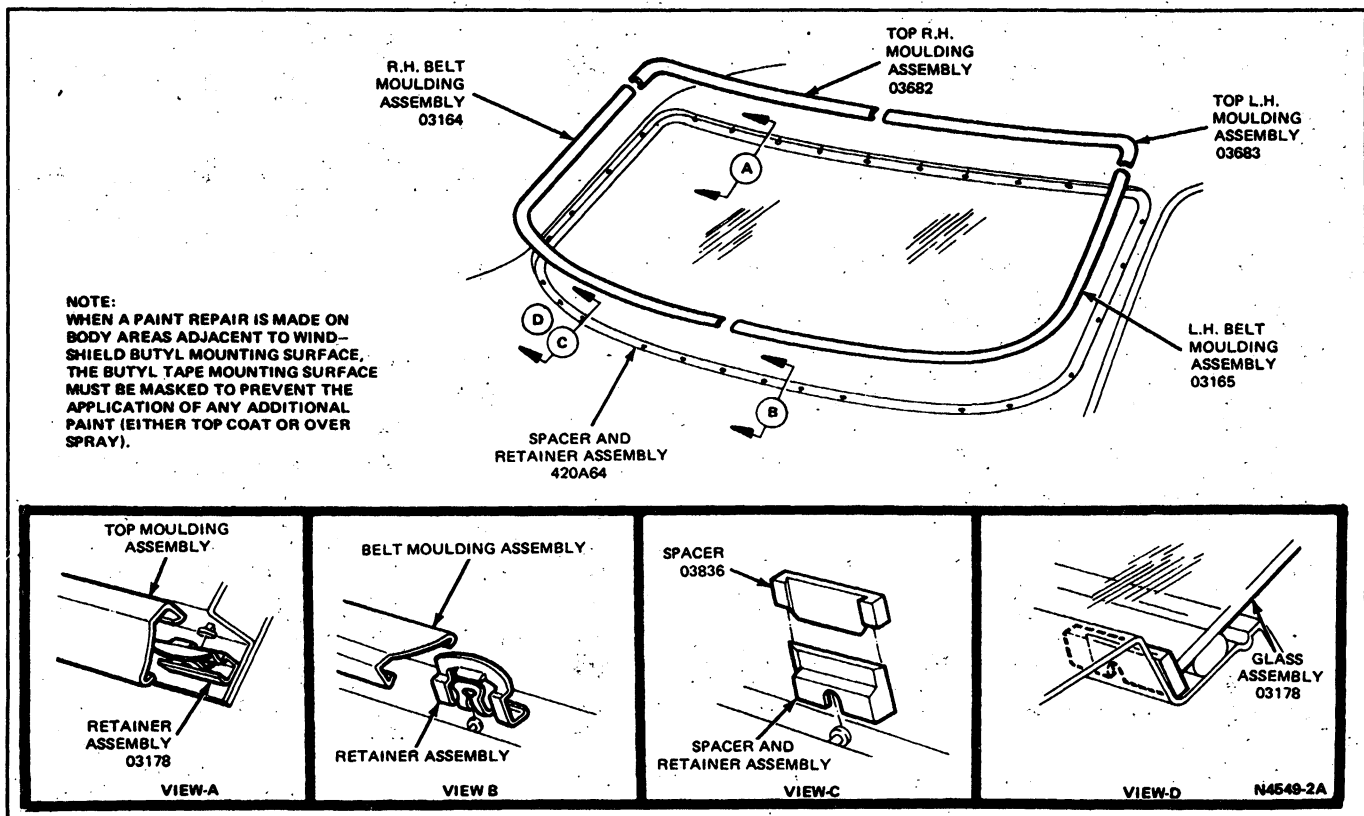


FIG. 4 Windshield Clips and Mouldings—E-150—E-350

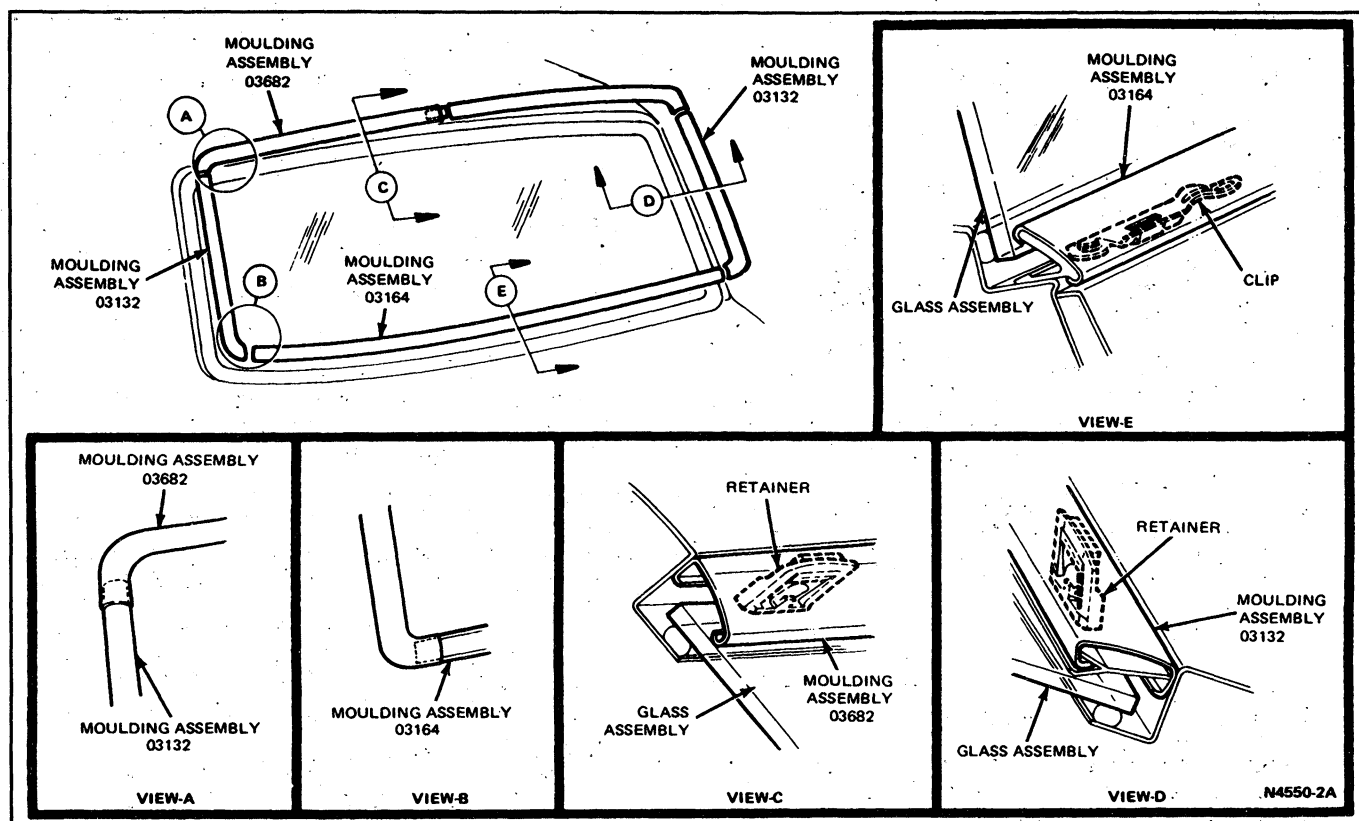


FIG. 5 Windshield Exterior Mouldings—F-150—F-350, F-Super Duty and Bronco

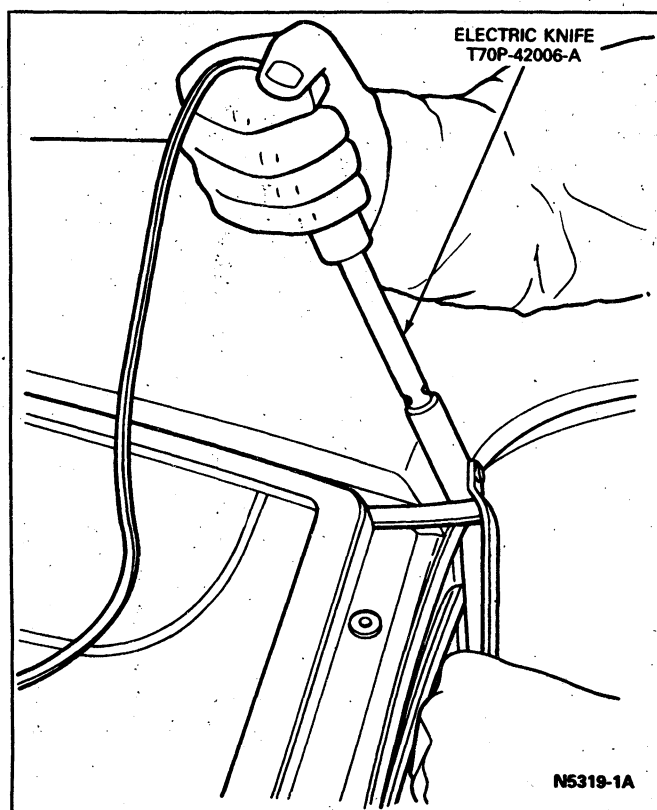


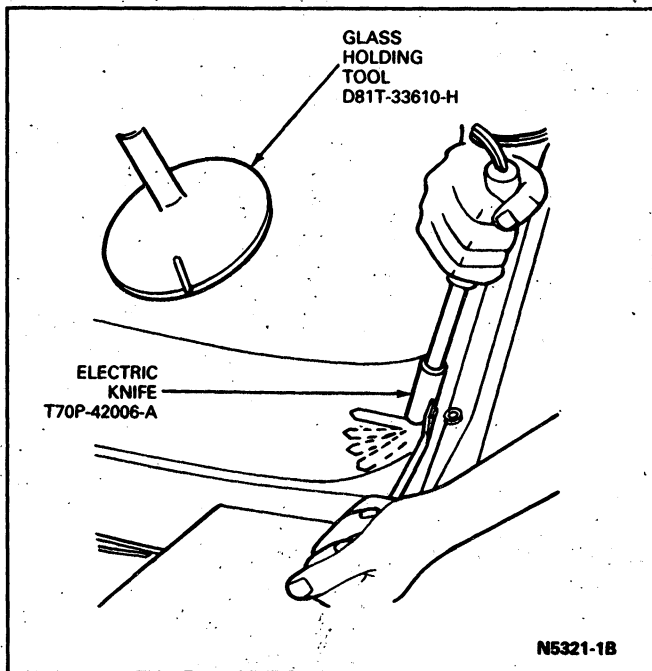
FIG. 6 Removing Butyl-Type Seal—Typical

7. Clean all remaining butyl from the pinch weld flange.

8. Inspect flange carefully for sheet metal deficiencies, and the sealing surface of the pinch weld flange for chipped or missing paint. Repair as necessary. Pinch weld flange must be primed with Metal Primer ESB-2C171-AB or equivalent before applying butyl tape.

#### Installation

- Starting at the midpoint on A-pillar, apply the butyl tape around the opening as shown in Fig. 10, View B.
- Cut the butyl at the required length on a 45-degree angle and carefully splice the two loose ends. The splice cut line must taper down and toward the outboard side of the vehicle (Fig. 10, View A).
- Apply the glass primer (furnished in the kit) around the perimeter of the cleaned inside surface and the edge of the glass in the area that will contact the butyl seal.
- Allow the primer to dry a minimum of five minutes before installing the glass.
- Place the glass in the opening, aligning the crayon marks.
- Firmly press the glass against the butyl with hand pressure or weights (approximately 113 kg (250 lb)). Ensure 4.8mm (3/16-inch) contact on A-pillar, 9.5mm (3/8-inch) contact on header and cowl between glass and butyl is achieved. A dull spot indicates an area where the butyl is not contacting the glass surface. Additional pressure should seal such areas.
- From outside the vehicle, apply Liquid Butyl Sealer C9AZ-19554-B or equivalent around the entire edge of the glass.



**FIG. 7 Cutting Corner Seal—Typical**

8. Remove any excess primer from the inside surface of the glass with a razor blade. Wipe glass with a clean cloth dampened with naphtha.
9. When the liquid butyl has skinned-over (approximately 10 minutes), water test the installation. If necessary, repair any leaks with additional liquid sealer.
10. Install the exterior mouldings and wiper arms and blades.
11. Clean the glass and surrounding area.

### Side Window

#### F-150—F-350 Super Cab

Refer to Fig. 11.

### Removal

1. Remove interior trim around window.
2. Remove 10 self-threading nuts from inside the window assembly and remove the moulding assembly.
3. Remove the glass assembly by pushing with enough pressure to separate the butyl seal.
4. Clean the old seal from the body recess and from the glass assembly. All traces of the old sealing material must be removed.
5. Inspect for sheet metal deficiencies. Check the sealing surface of the flange for chipped or missing paint. Repair as necessary.

### Installation

1. Apply new Butyl Tape D9AZ-19562-B or equivalent around the outer perimeter of the body recess.
2. Press window assembly into place. Use enough pressure to seat the glass firmly in the sealing material, but avoid damaging or distorting window assembly.
3. Install moulding assembly.
4. Install 10 self-threading nuts and run up snug. Do not overtighten.

### Sealing Leaks

If water or dust enters the window, follow Steps 1 and 2 of Side Window Removal. Run a bead of clear Silicone Rubber D6AZ-19562-A or equivalent around the entire perimeter of the glass. Immediately install the moulding assembly and nuts, and tighten. Then, carefully wipe away any visible silicone seal. Use a clean cloth, changing the wiping surface often. Make sure to remove all silicone seal from the sheet metal and moulding assembly. This must be done within three minutes of running the bead around the glass.

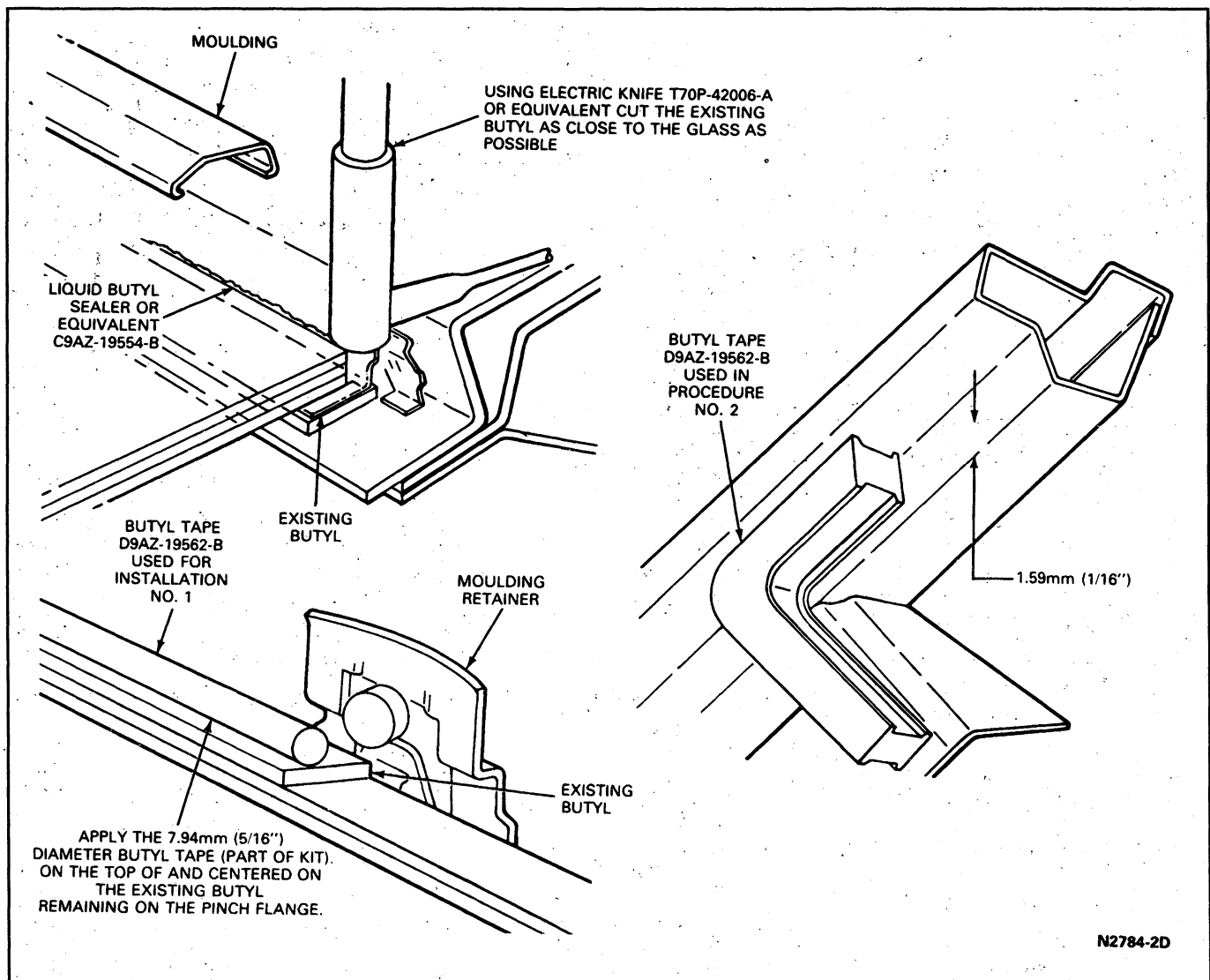


FIG. 8 Tape Installation

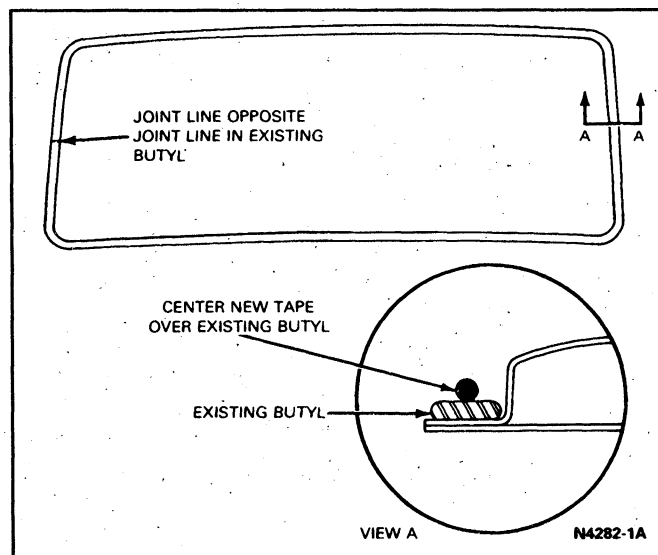


FIG. 9 Procedure No. 1—Butyl Tape Installation

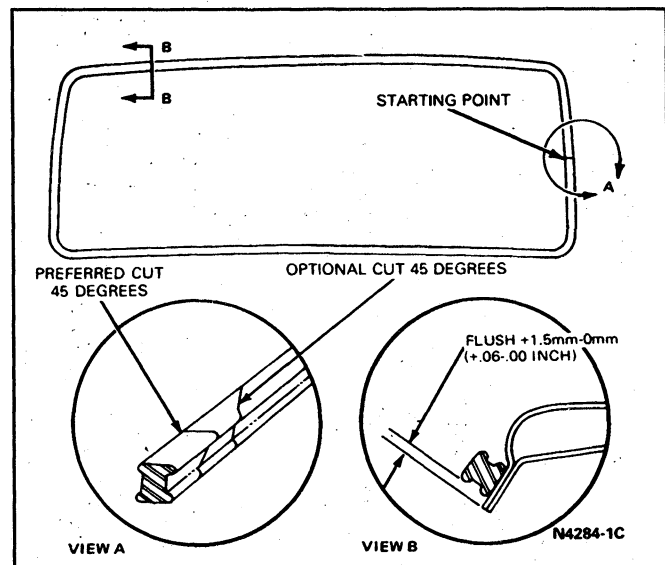
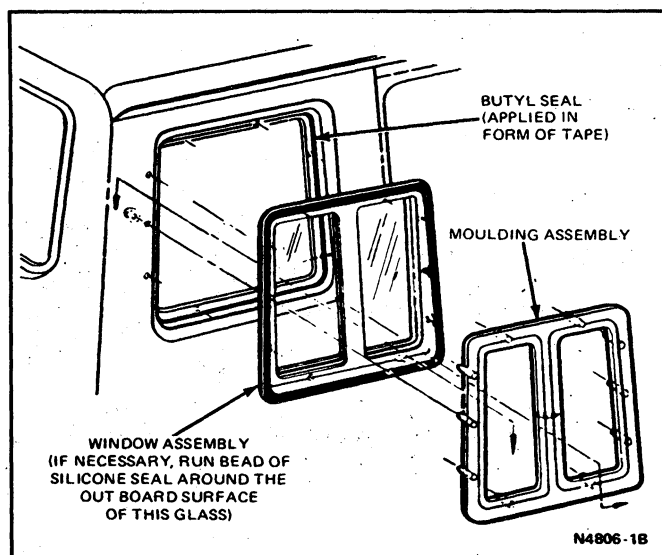


FIG. 10 Procedure No. 2—Single Row Butyl Tape Replacement





**FIG. 11 F-150—F-350 Super Cab Side Window Installation**

**SPECIAL SERVICE TOOLS**

Tool Number	Description
T64P-42006-B	Moulding Removal Tool
T64P-42006-C	Moulding Removal Tool
T70P-42006-A	Electric Knife
T70P-42006-AA	Replacement Knife Blades
D81T-33610-H	Glass Holding Tool

CN4601-1D

# DOORS, HOOD AND TAILGATE

## GROUP **44**

(16000 & 17000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
DOOR LATCHES AND LOCKS .....	44-11-1	HOOD LATCH .....	44-31-1
DOORS, HINGES, CHECKS AND WEATHERSTRIPS .....	44-06-1	POWER DOOR LOCKS .....	44-16-1
DOORS, HOOD AND TAILGATE GENERAL SERVICE .....	44-01-1	SLIDING DOOR .....	44-08-1
HOOD AND HINGES .....	44-21-1	TAILGATE .....	44-86-1
		TAILGATE WEATHERSTRIP .....	44-92-1

## SECTION 44-01 Doors, Hood and Tailgate General Service

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		DESCRIPTION (Cont'd)	
Door and Window Weatherstrip Lubricant .....	44-01-1	Lock Cylinder Lubricant .....	44-01-1
Door, Hood and Tailgate Hinges— Lubricant .....	44-01-1	VEHICLE APPLICATION .....	44-01-1

### VEHICLE APPLICATION

E-150—E-350, F-150—F-350 and Bronco.

### DESCRIPTION

#### Door and Window Weatherstrip Lubricant

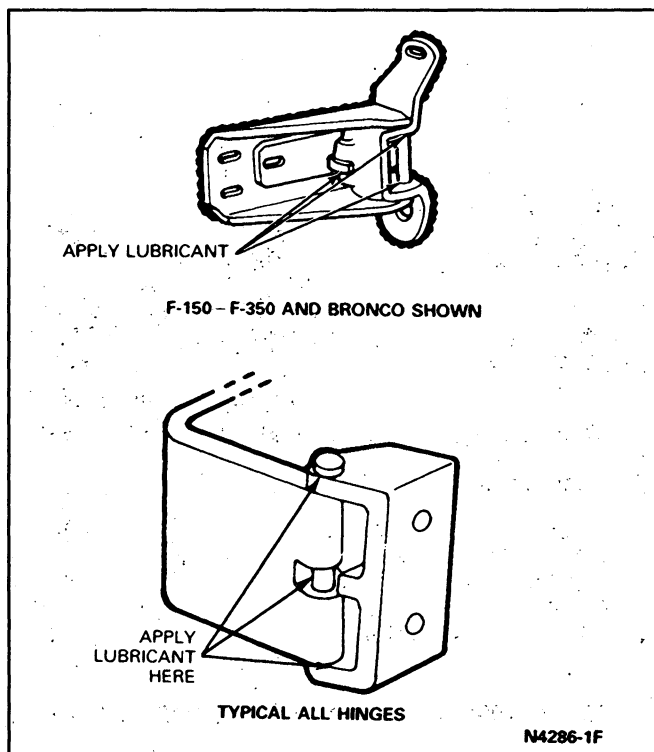
**CAUTION:** Silicone Lubricant is not recommended on any door or door weatherstrips since it will soften all painted surfaces that contact the weatherstrip. If a lubricant is required, a soapy solution is acceptable.

#### Door, Hood and Tailgate Hinges—Lubricant

Use Multi-Purpose Grease Spray D7AZ-19584-AA or equivalent to lubricate door hinges. Apply an even coat to all movable hinge surfaces as outlined in the maintenance schedules or when a binding or squeaking condition occurs (Fig. 1).

#### Lock Cylinder Lubricant

Apply Lock Lubricant D8AZ-19587-A or equivalent to prevent sticking or binding of all key lock cylinders.



**FIG. 1 Door Hinge Lubrication—Typical**

# SECTION 44-06 Doors, Hinges, Checks and Weatherstrips

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Front Door Alignment .....	44-06-1	Door Weatherstrips .....	44-06-3
Bronco and F-150—F-350 .....	44-06-1	E-150—E-350 .....	44-06-3
E-150—E-350 .....	44-06-1	F-150—F-350 and Bronco .....	44-06-3
Hinged—Side Cargo and Back Door Alignment .....	44-06-1	Doors .....	44-06-1
E-150—E-350 .....	44-06-1	<b>VEHICLE APPLICATION</b> .....	44-06-1
<b>REMOVAL AND INSTALLATION</b>			
Door Hinge .....	44-06-3		
Bronco, F-150—F-350 and E-150—E-350 .....	44-06-3		

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350 and Bronco.

## ADJUSTMENTS

### Front Door Alignment

**CAUTION:** Do not cover up a poor alignment with a latch striker adjustment.

#### E-150—E-350

The door hinges provide sufficient adjustment to correct most door misalignment conditions. The holes of the hinge and/or hinge attaching points are enlarged or elongated to provide for hinge and door alignment (Fig. 1).

#### Front Door

1. Determine which hinge bolts must be loosened to move the door in the desired direction (Fig. 1).
2. Loosen the hinge bolts just enough to permit movement of the door with a padded pry bar.
3. Move the door the distance estimated to obtain the desired fit. Tighten the hinge bolts and check the door fit to ensure there is no bind or interference with the adjacent panel.
4. Repeat the operation until the desired fit is obtained. Then, check the striker plate alignment for proper door closing. Refer to Section 44-11, Door Latches and Locks.

#### Bronco and F-150—F-350

1. Refer to Figs. 2 and 3, to determine which hinge bolts must be loosened to move the door in the desired direction.
2. Loosen the hinge bolts just enough to permit movement of the door with a padded pry bar.
3. Move the door the distance estimated to obtain the desired fit. Tighten the hinge bolts and check the door fit to ensure there is no bind or interference with the adjacent panel.

4. Repeat the operation until the desired fit is obtained. Check the striker plate alignment for proper door closing.

### Hinged—Side Cargo and Back Door Alignment

#### E-150—E-350

The door hinge attachment to the door and body provide a means for adjusting the doors in the body opening. Up or down and in or out adjustment is provided by enlarged holes at the hinge-to-door attachment (Fig. 4). Side-to-side movement of the doors is provided by horizontally elongated holes at the hinge-to-body attachment (Fig. 4).

The cargo doors should be adjusted to obtain a proper fit. After the doors have been adjusted, tighten the hinge attaching bolts securely, and adjust the latch mechanisms, if required.

## REMOVAL AND INSTALLATION

### Doors

#### Removal and Installation

1. Remove all usable hardware, trim, and glass parts. Refer to Sections 45-03, Door Trim Panels; 42-04, Front Door Window Glass and Mechanisms; 42-25, Pivot-Type Rear Door and Side Window; and 42-15, Vent Window Mechanisms.
2. Remove the upper and lower hinge access hole cover plates, if so equipped. Mark the location of the hinge on the door and body.
3. Remove the door-to-lower hinge retaining bolts (Figs. 1 through 4).
4. Support the door, and remove the door-to-upper hinge retaining bolts. Slide the door off the hinges (Figs. 1 through 4).
5. If a hinge is to be replaced, remove the hinge-to-pillar bolts, and remove the hinge.
6. Cement the door weatherstrip in proper position on the door using Weatherstrip Adhesive COAZ-19552-A or equivalent. Include the belt seals.

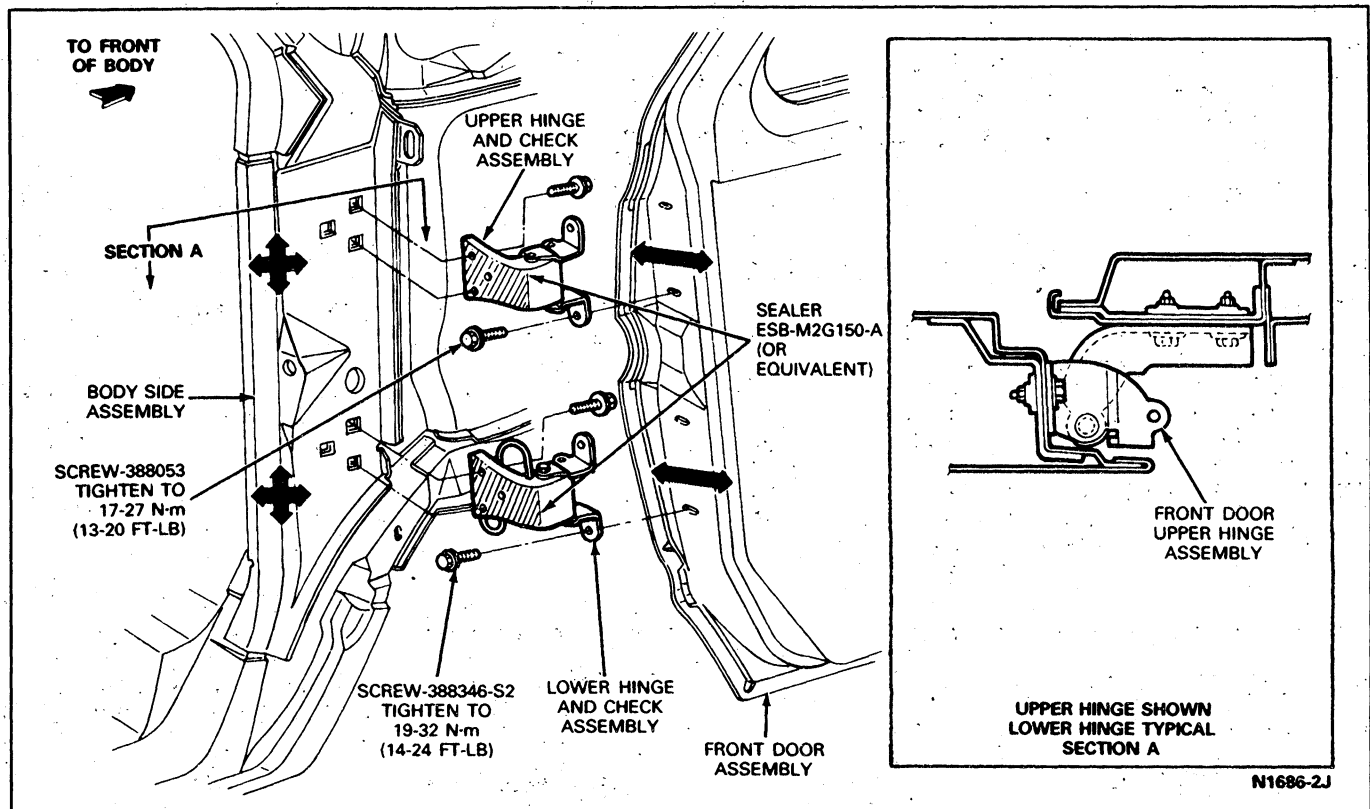


FIG. 1 Front Door Hinge Adjustment—E-150—E-350

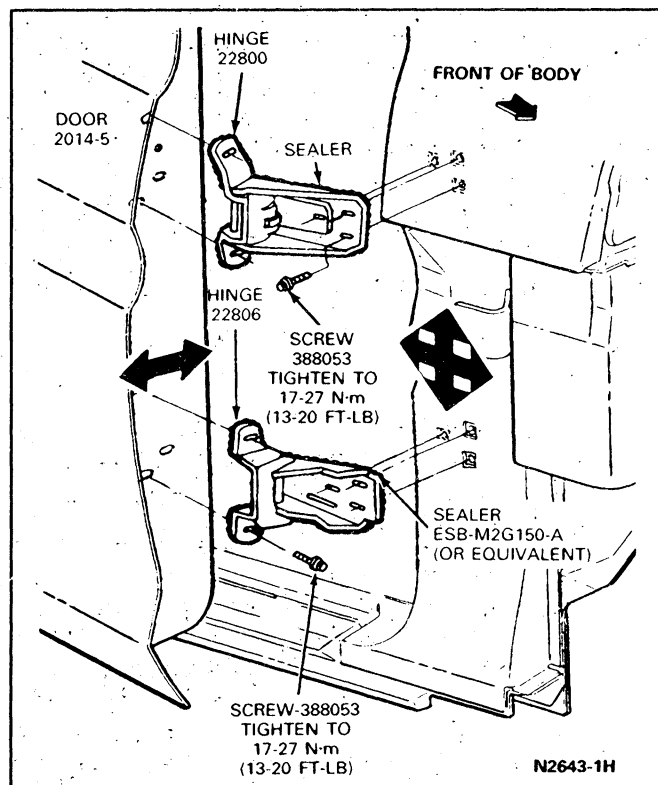


FIG. 2 Door Hinge Adjustment—Bronco and F-150—F-350

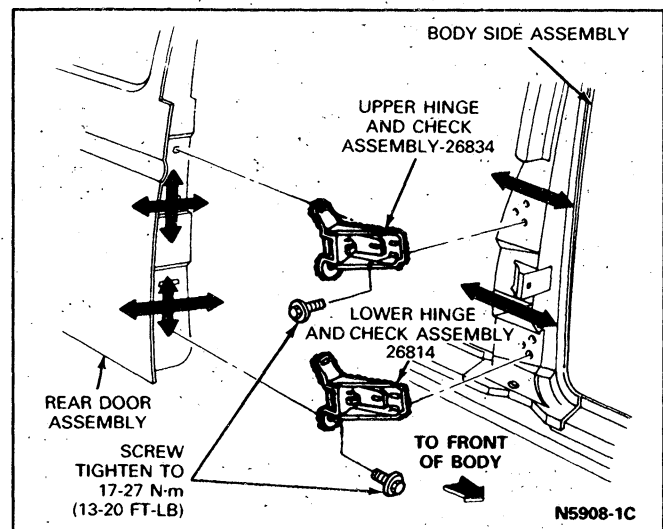
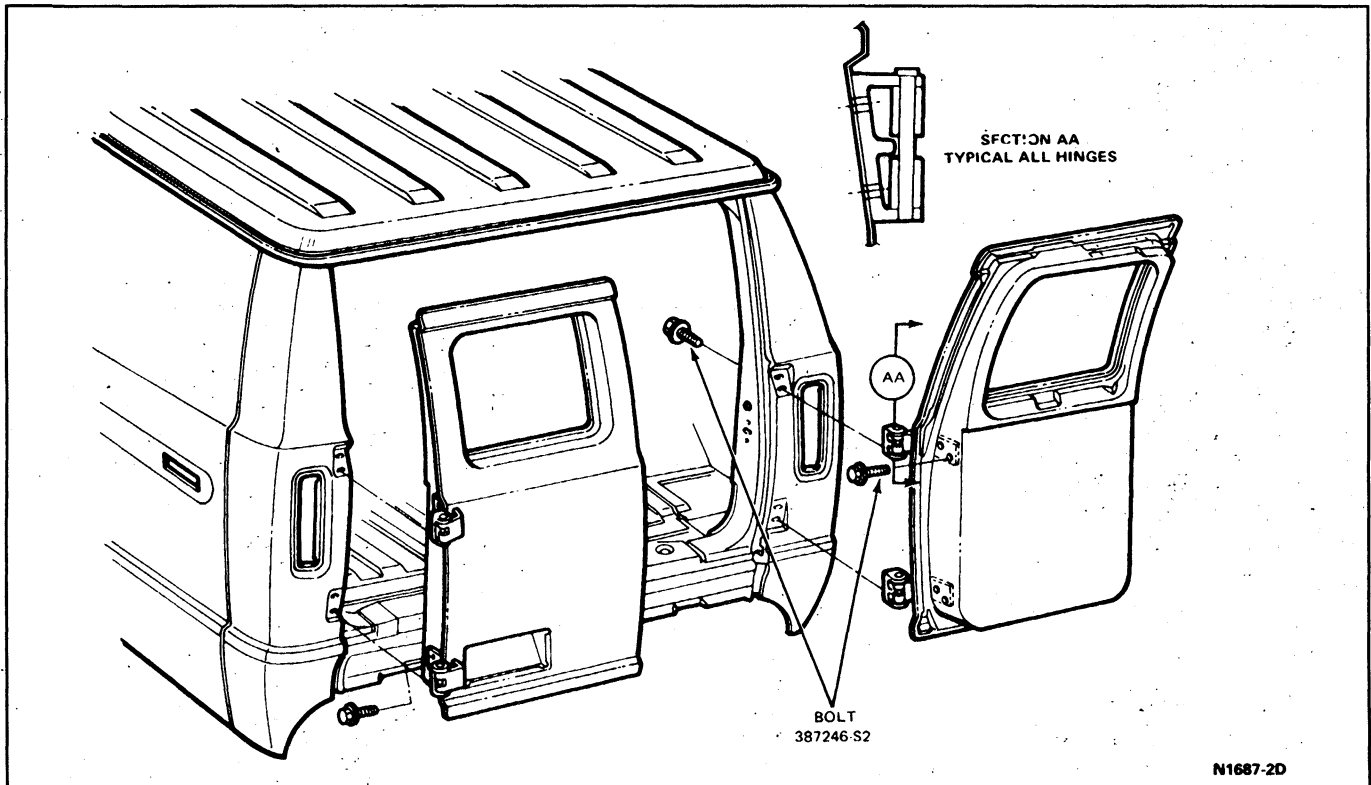


FIG. 3 Rear Door Hinge Adjustment—F-350 Crew Cab

7. If a hinge has been removed, install the hinge in the pillar in approximately the same position as the removed hinge.
8. Position the door on the hinges, and install the retaining bolts snug (Figs. 1 through 4).
9. Install the lock mechanism. Refer to Section 44-11, Door Latches and Locks. Install the glass mechanism, glass, and vent window assembly. Make all necessary adjustments as these assemblies are installed. Refer to Sections 45-03, Door Trim Panels; 42-04, Front Door Window Glass and Mechanisms; 42-25, Pivot-Type Rear Door and Side Window and 42-15, Vent Window Mechanisms.
10. Adjust the door and tighten all hinge bolts securely. To provide a good weatherstrip seal, the upper



**FIG. 4 Hinged Side Cargo and Back Door Alignment—E-150—E-350**

front edge of the door must be 4.8mm (3/16 inch) inboard of the upper part of the pillar from the belt line to a point near the top of the door. This adjustment is made by adjusting the upper striker of the RH door inboard 4.8mm (3/16 inch) (Figs. 1 through 4).

11. If the truck is so equipped, install the watershield. The top edge should be cemented to the inside surface of the inner panel.
12. Install the hinge access hole cover plates. Install door access hole cover plate.

### Door Hinge

#### Bronco, F-150—F-350 and E-150—E-350

##### Removal and Installation

1. Support the door.
2. Mark the location of the hinge on the door and body.
3. Remove the hinge-to-body attaching bolts (Figs. 1 through 4).
4. Remove the hinge-to-door attaching bolts and remove the hinge.
5. Position the new hinge to the door and body, and install the attaching bolts.
6. Adjust the door and hinges. Remove the support.

### Door Weatherstrips

#### E-150—E-350

##### Removal and Installation

Refer to Figs. 5 through 8.

1. Remove the weatherstrip.
2. Clean all old weatherstrip adhesive and apply new Weatherstrip Adhesive C0AZ-19552-A or equivalent to the door and retaining flanges.
3. Apply Weatherstrip Adhesive C0AZ-19552-A or equivalent to the weatherstrip.
4. Install the weatherstrip.
5. Cut the weatherstrip 3.2mm (1/8 inch) long. Cover the ends with Weatherstrip Adhesive C0AZ-19552-A or equivalent, and butt the ends together.

#### F-150—F-350 and Bronco

##### Removal and Installation

1. Remove weatherstrip by pulling from body flange.
2. Install weatherstrip by pushing onto flange around entire door opening (Figs. 9 and 10).
3. Use a roller to seat the weatherstrip on the flange.
4. Trim the weatherstrip to proper length.
5. Butt the ends of the weatherstrip at the bottom of the door opening.
6. An adhesive-backed weatherstrip is also applied to the upper door (Fig. 9).

A secondary weatherstrip is also used on the door of XLT and Lariat models (Fig. 9). Remove the weatherstrip and clean all old weatherstrip adhesive from the door. Replacement weatherstrip has paper backed adhesive on the attachment surface. Peel off paper backing and apply seal to the door inner panel Fig. 9.

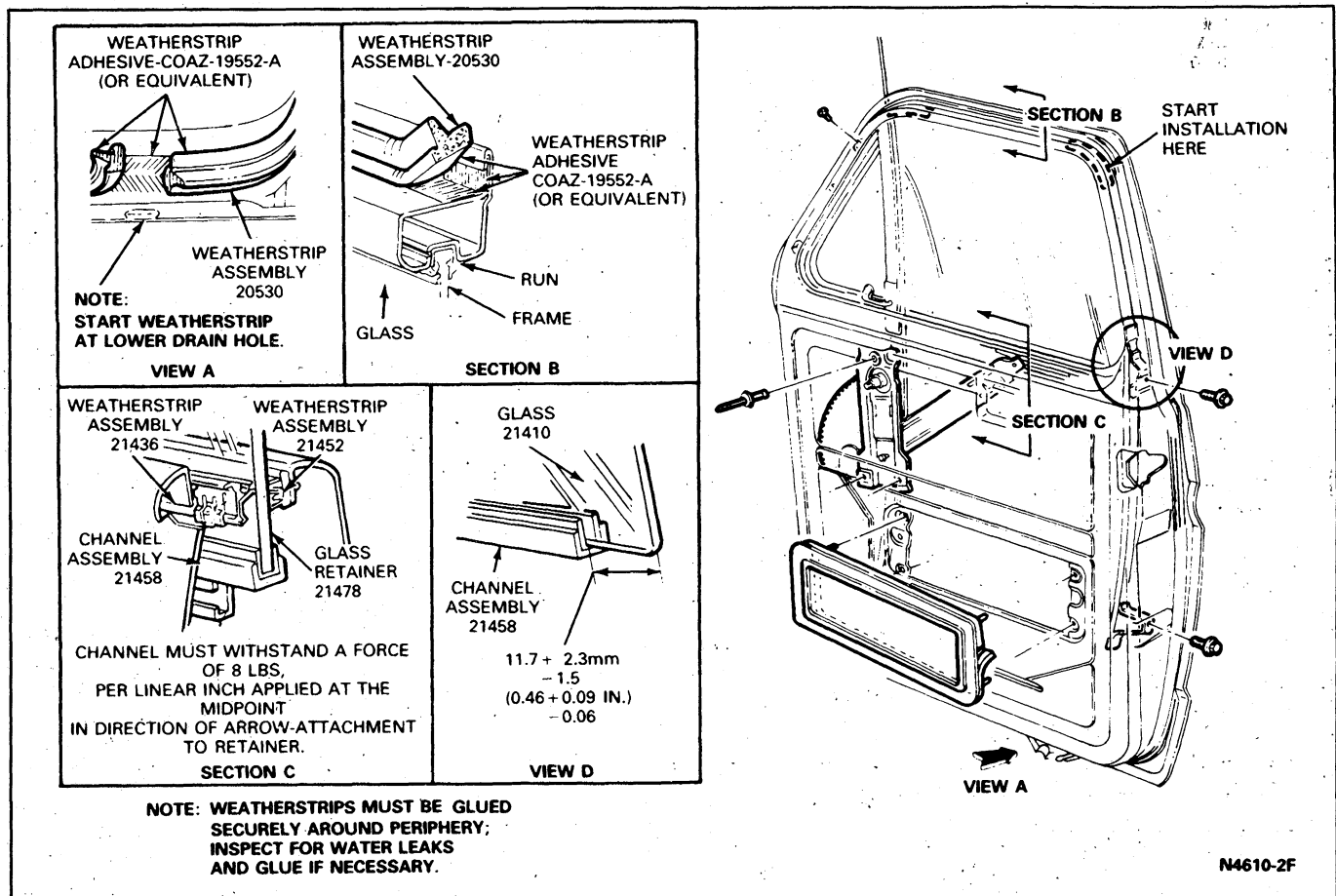


FIG. 5 Front Door Weatherstrip—E-150—E-350

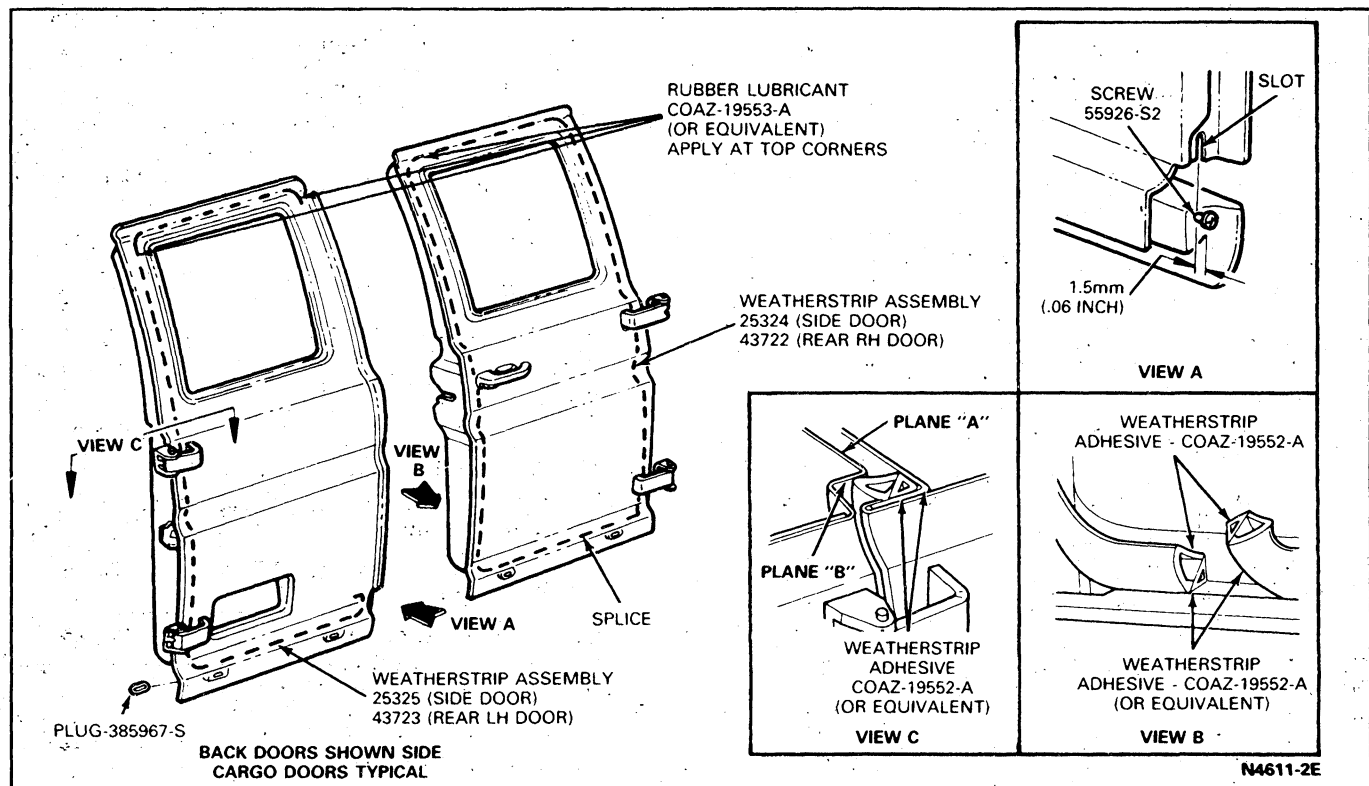


FIG. 6 Side Cargo and Back Doors Weatherstrip—E-150—E-350

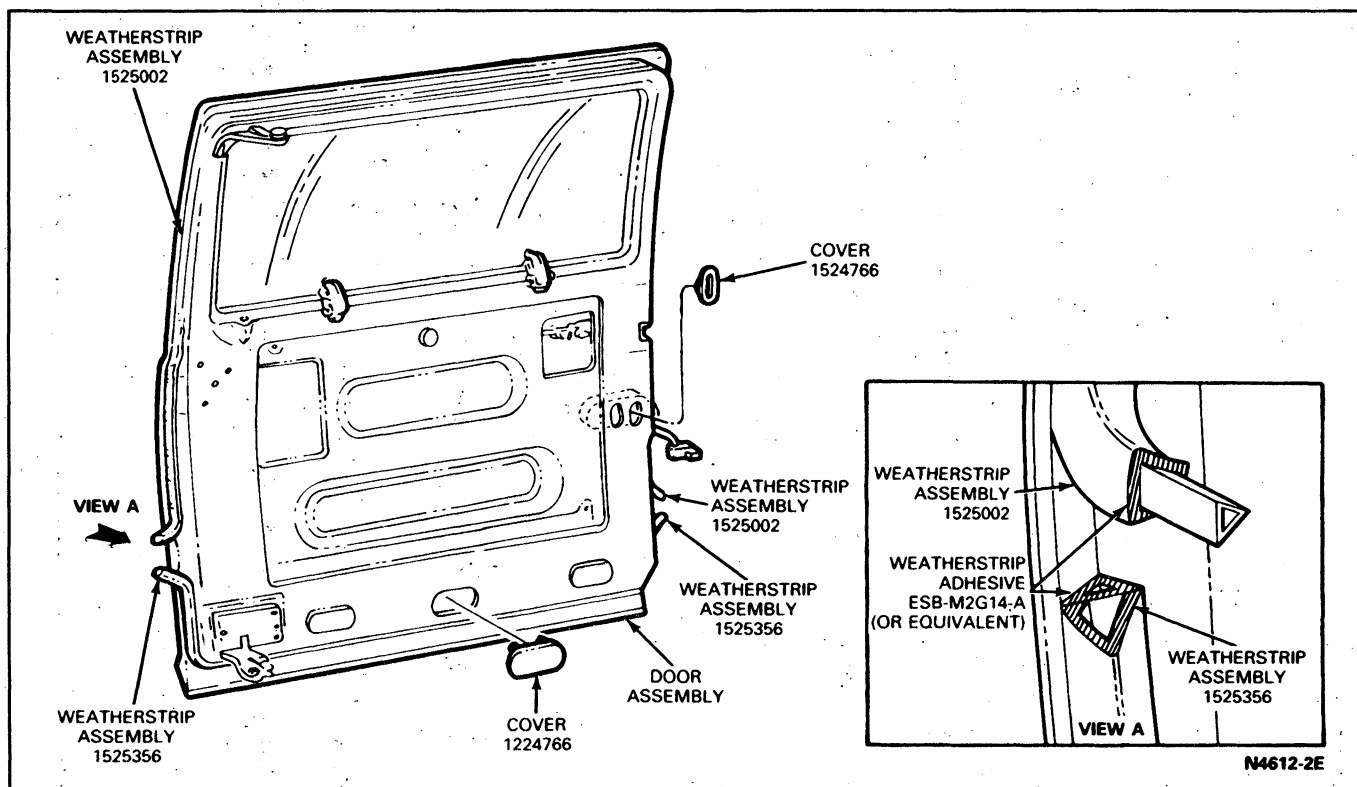


FIG. 7 Sliding Door Weatherstrip—E-150—E-350

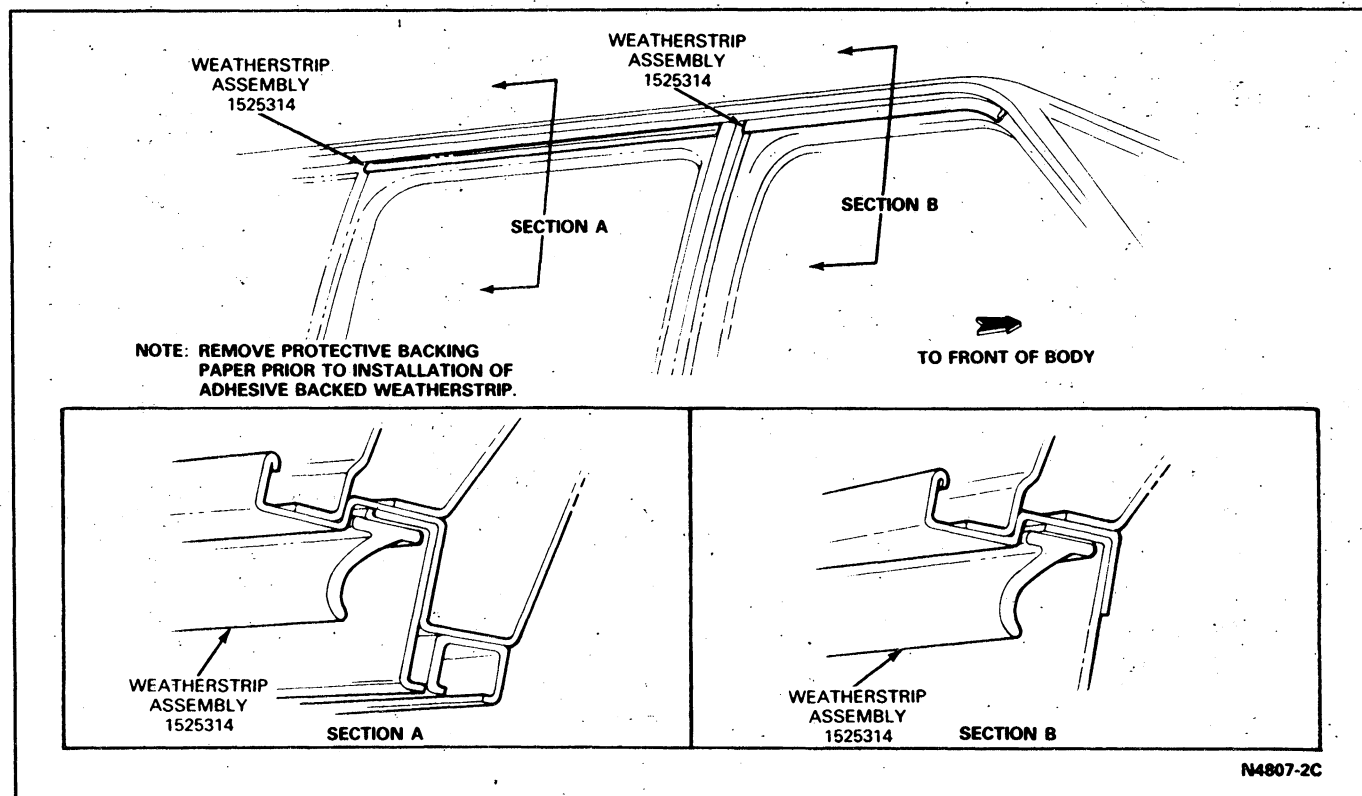


FIG. 8 Body Side Door Opening Weatherstrips—E-150—E-350



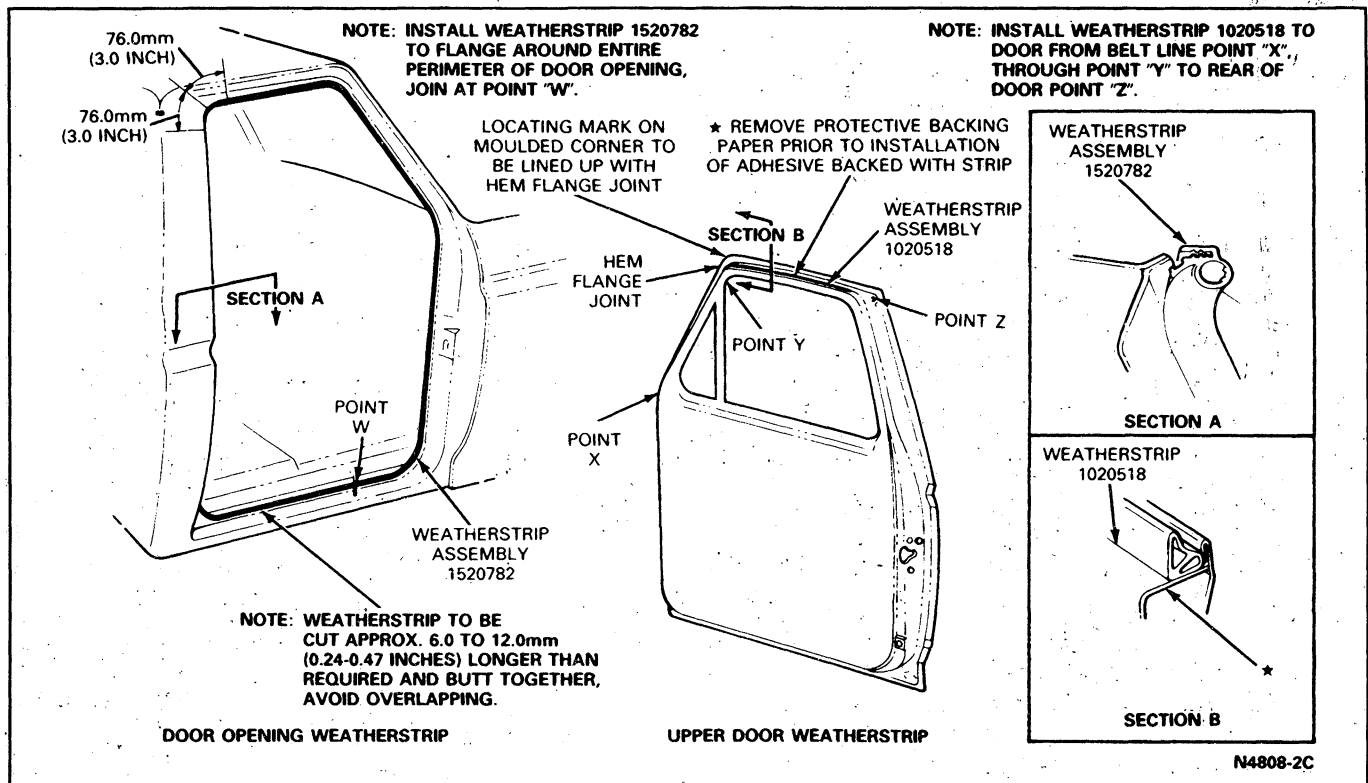


FIG. 9 Door Opening and Upper Door Weatherstrips—F-150—F-350 and Bronco

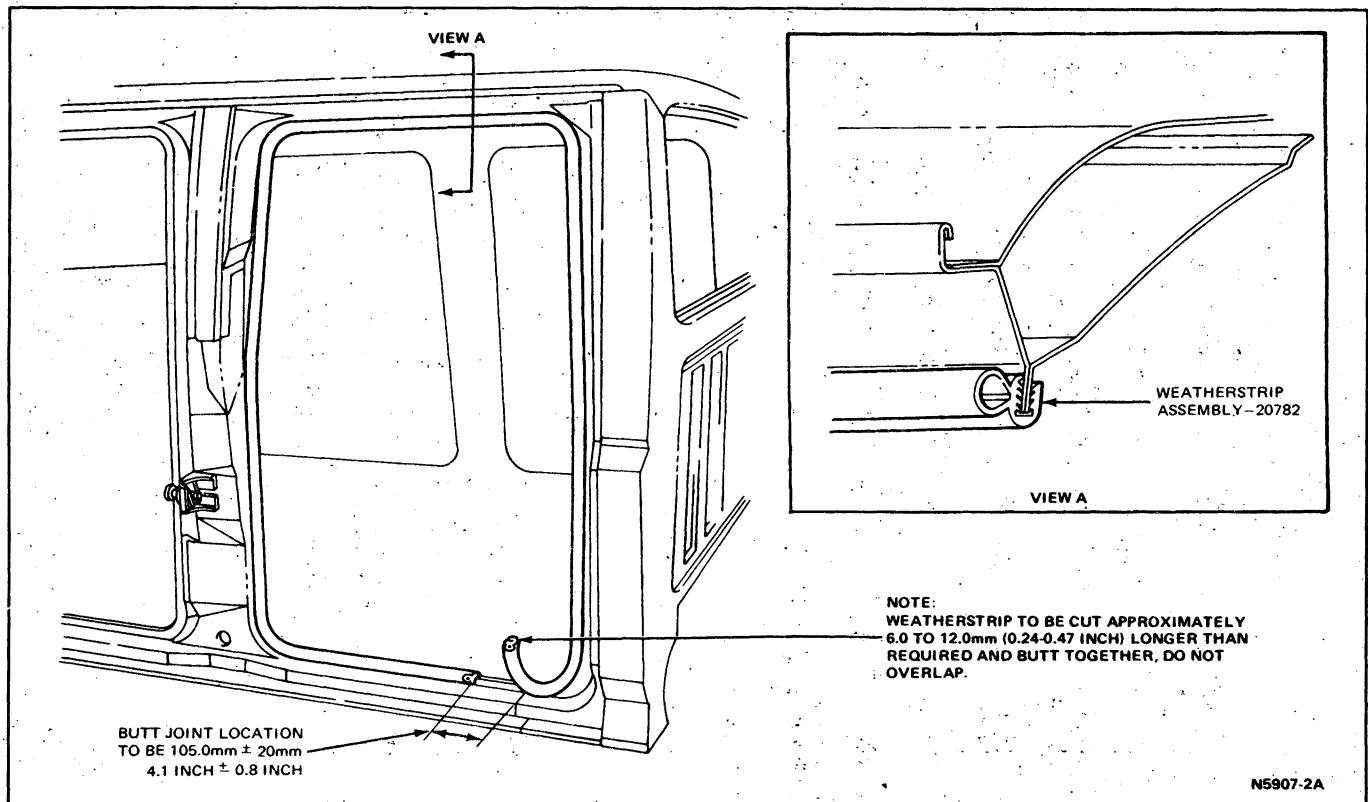


FIG. 10 Rear Door Weatherstrip—F-350 Crew Cab

## SECTION 44-08 Sliding Door

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>DESCRIPTION AND OPERATION</b> .....	<b>44-08-1</b>
Fore and Aft .....	44-08-3	<b>REMOVAL AND INSTALLATION</b>	
Center Hinge Check and Front		Door Hinge Assembly .....	44-08-7
Striker .....	44-08-3	Door Latch—Front .....	44-08-6
Lower Check .....	44-08-3	Door Latch—Rear .....	44-08-6
In or Out .....	44-08-1	Lower Guide Assembly .....	44-08-3
Front Lower .....	44-08-1	Striker—Front Latch .....	44-08-8
Front Upper .....	44-08-1	Upper Bracket and Roller Assembly .....	44-08-3
Rear—Upper and Lower .....	44-08-1	Weatherstrips .....	44-08-8
Up or Down .....	44-08-1	<b>VEHICLE APPLICATION</b> .....	<b>44-08-1</b>
Front .....	44-08-1		
Hinge Assembly .....	44-08-1		
Striker—Rear Latch .....	44-08-1		

### VEHICLE APPLICATION

E-150 Through E-350.

### DESCRIPTION AND OPERATION

The door is operated by rotating the inside or outside handle (inside-rearward or outside-downward) to release the latch and by sliding the door rearward to the full open position. When the door has been pushed fully rearward, the hold-open check will activate and prevent the door from inadvertently closing. There are no intermediate hold-open positions. To close the door, the inside or outside handle must be activated (inside-forward or outside-upward) to release the door from the check position.

If the door is slammed with sufficient force, the latch will engage the striker in the primary position and the door panel will become flush with the body panel. A door slammed with less force may allow the rear latch (Fig. 1) to engage the rear striker (Fig. 2) in the secondary position. In this event, the door may be placed in the primary or fully-latched position by rotating the inside or outside handle (inside - forward, outside - upward) until a click is heard.

The door can be locked by pushing down on the lock knob and closing the door, or by pushing down the lock knob after door is closed.

### ADJUSTMENTS

#### In or Out

##### Front Upper

To adjust the upper edge of the door, loosen the upper roller retaining nut and move the roller in or out to obtain a flush fit with the body sheet metal at the top edge of the door (Fig. 1, View D).

##### Front Lower

Support the door assembly so that **no up or down** movement can be made to the door when performing the in or out adjustment.

To adjust the lower front edge of the door, loosen the retaining screws on the guide assembly and move the

guide assembly **forward** to obtain a snug fit to the body, and **rearward** to move it away from the body, at the B-pillar post (Fig. 1, View E).

#### Rear—Upper and Lower

To move rear edge of door in or out, open door and loosen and adjust rear latch striker as required (Fig. 2, View A). Tighten striker.

#### Up or Down

##### Front

To move the front edge of the door up or down, loosen the three lower guide attaching screws (Fig. 1, View E). Then, rotate the guide at the lower attaching screw to obtain the desired door **up or down** position.

Loosen the upper roller bracket assembly attaching screws. Adjust the bracket so that the bottom edge of the roller assembly is approximately 1.58mm (1/16 inch) from the bottom flange of the upper track (Fig. 2, View B).

#### Hinge Assembly

To move the rear edge of door up or down, remove the rear hinge assembly mounting bolt covers. Then, loosen the four rear hinge assembly mounting bolts and move hinge assembly up or down until the hinge pin is observed to be horizontal and the roller properly sitting on the center track (Fig. 1, View C). Tighten the mounting screws. Open door and check striker-to-rear latch alignment. Adjust the rear latch striker up or down as required (Fig. 2, View A). Tighten striker. Close the door slowly. Ensure the rear latch striker clears the inboard tang on the latch pawl.

#### Striker—Rear Latch

To adjust the rear edge of the door in or out, mark the location of the rear striker, loosen and move the striker in or out to obtain a flush fit with the body sheet metal. Tighten striker (Fig. 3, View B).

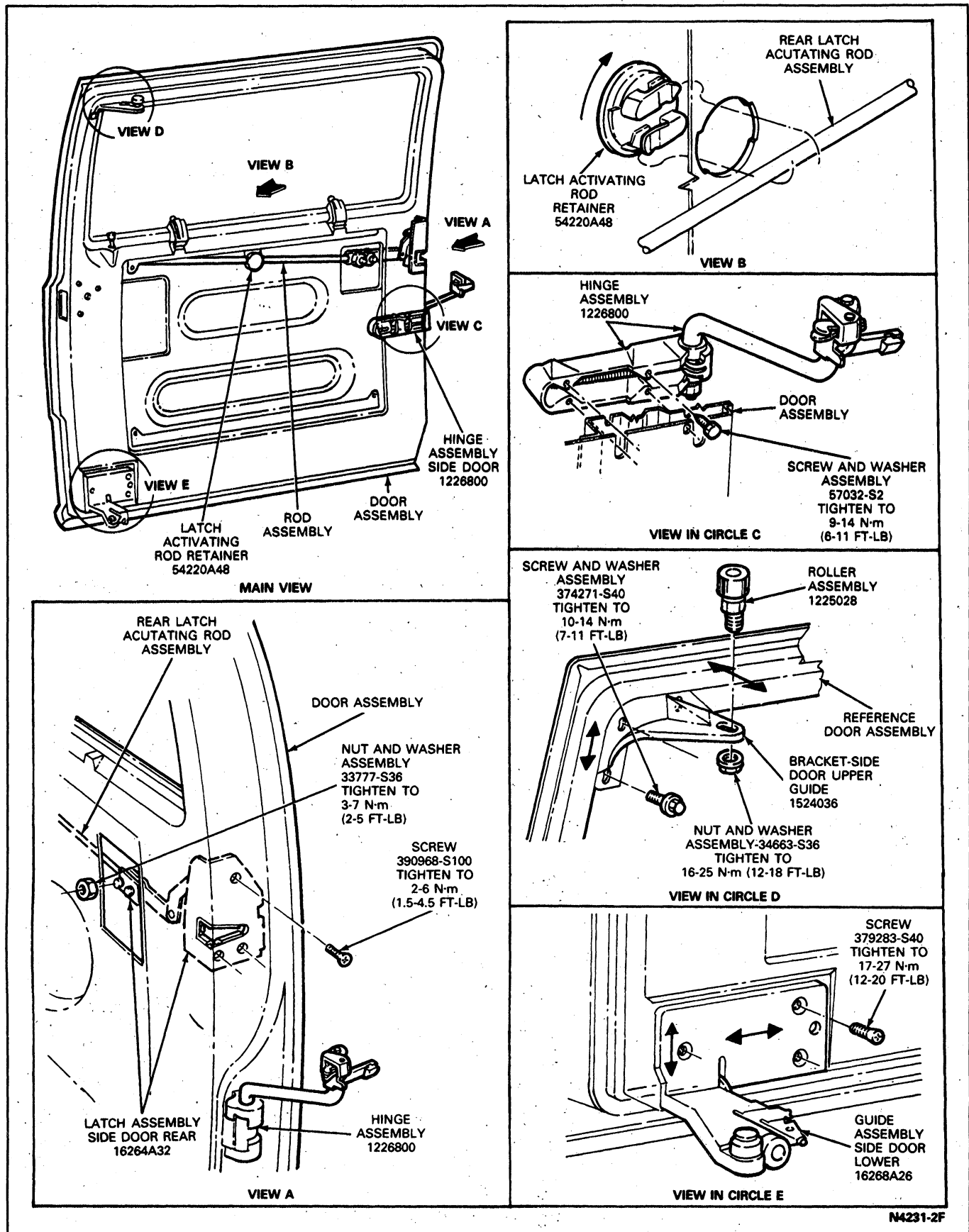


FIG. 1 Sliding Door Adjustments—In or Out or Up or Down

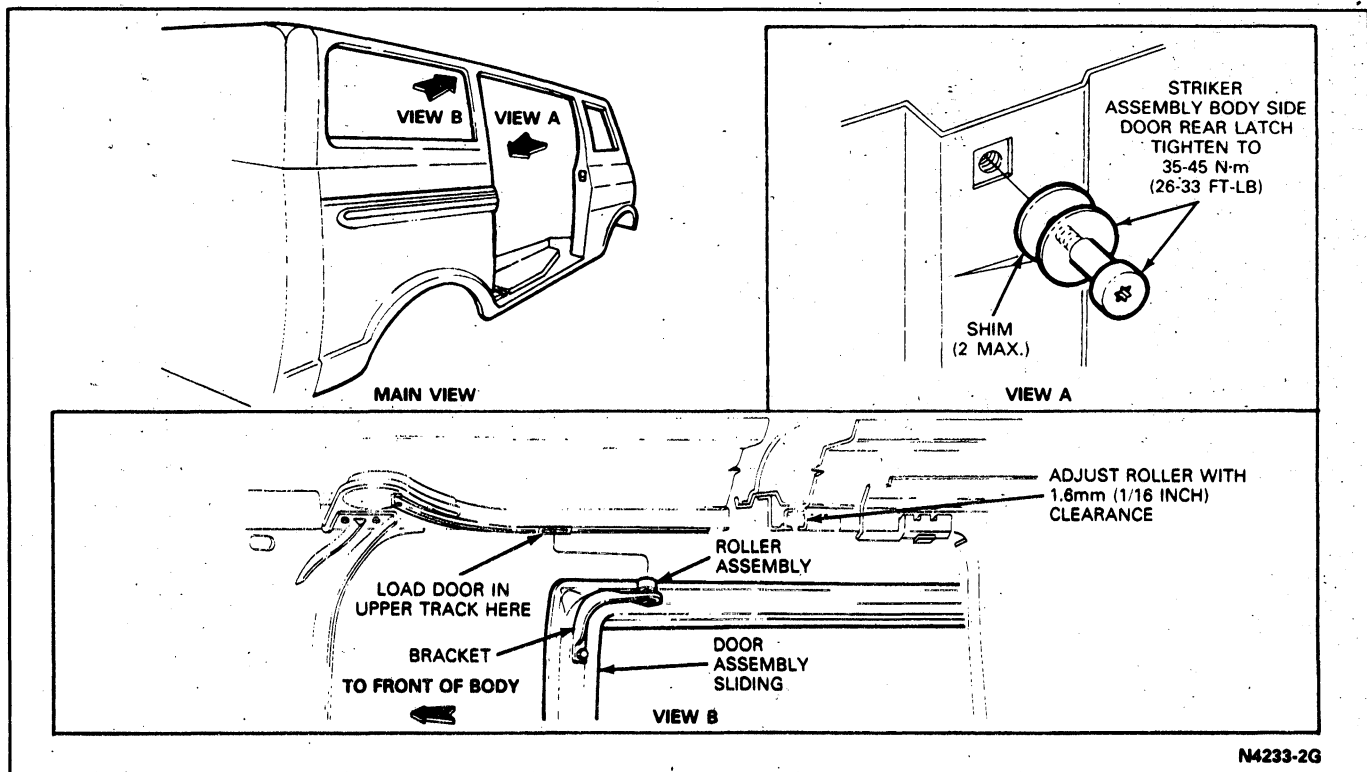


FIG. 2 Sliding Door—Guides and Rollers

## Fore and Aft

### Center Hinge Check and Front Striker

To gain access to the hinge check, remove the two screws retaining the center track shield (Fig. 3, View B and View E). On the regular 3505mm (138-inch) wheel base van the rear side marker lamp must be removed to gain access to the center track rear attaching screws. Refer to Section 32-21, Parking, Rear and Marker Lamps. Remove center track shield by pushing it forward, clearing it from the slot position. It can now be removed by pulling it away from the body.

Loosen the hinge check screws (Fig. 3, View A). These bolts must be kept loose when making the fore-and-aft adjustment. Then remove the B-pillar post trim panel (nine screws). Loosen the two striker bolts and remove the striker (Fig. 3, View C). Then, install the front striker and shim as necessary to obtain the proper fit and operation of the front latch assembly. Close door with front and rear fully latched. Adjust the door check so it is fully engaged with the hinge lever hook and the check bumper is firmly depressed against the hinge casting (ensure check latching face is vertical). Tighten check screws.

### Lower Check

The lower check holds the sliding door assembly in the full open position (Fig. 3, View D).

No adjustment is required for this component.

## REMOVAL AND INSTALLATION

**NOTE:** Due to the conversion from single 90 degree Rod to double 90 degree Rod, it may be necessary to remove more parts than the instructions indicate. This action will allow more maneuverability of the Rod and ease the Removal Process.

## Upper Bracket and Roller Assembly

### Removal and Installation

1. Remove the upper garnish moulding. Open and support the door.
2. Mark the location of the upper bracket assembly to the door (Fig. 2).
3. Remove the screws retaining the bracket and roller assembly. Remove the assembly from the door, through the opening at the back of the upper track.
4. If a new bracket is being installed, transfer the roller assembly to the new bracket.
5. Position the bracket and roller assembly to the door. Install the three retaining screws (Figs. 1 and 2).
6. Adjust door as necessary to obtain proper fit, as outlined.

## Lower Guide Assembly

### Removal and Installation

1. Open and support the door.
2. Remove the lower guide check screws and remove the check.
3. Slide the door forward on the support to gain access to the lower guide attaching screws.
4. Mark the location of the lower guide bracket to the door (Fig. 1, View E), and remove the guide attaching screws. **To gain access to the stop actuating rod retainer assembly (Fig. 4, View A), rotate the guide assembly 90 degrees.** Then, disconnect the stop actuating rod from the stop and remove the guide assembly.

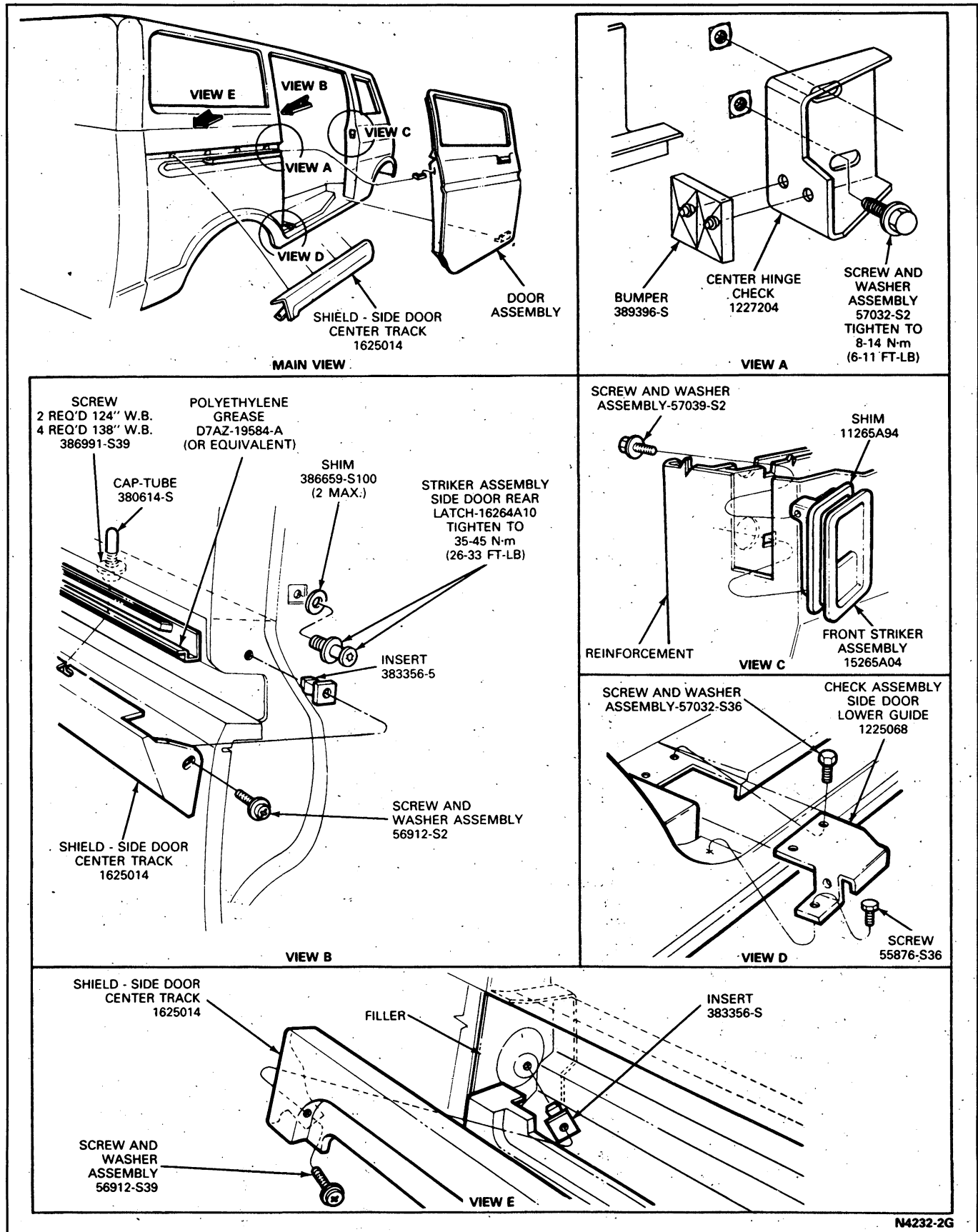


FIG. 3 Sliding Door Adjustments—Fore and Aft

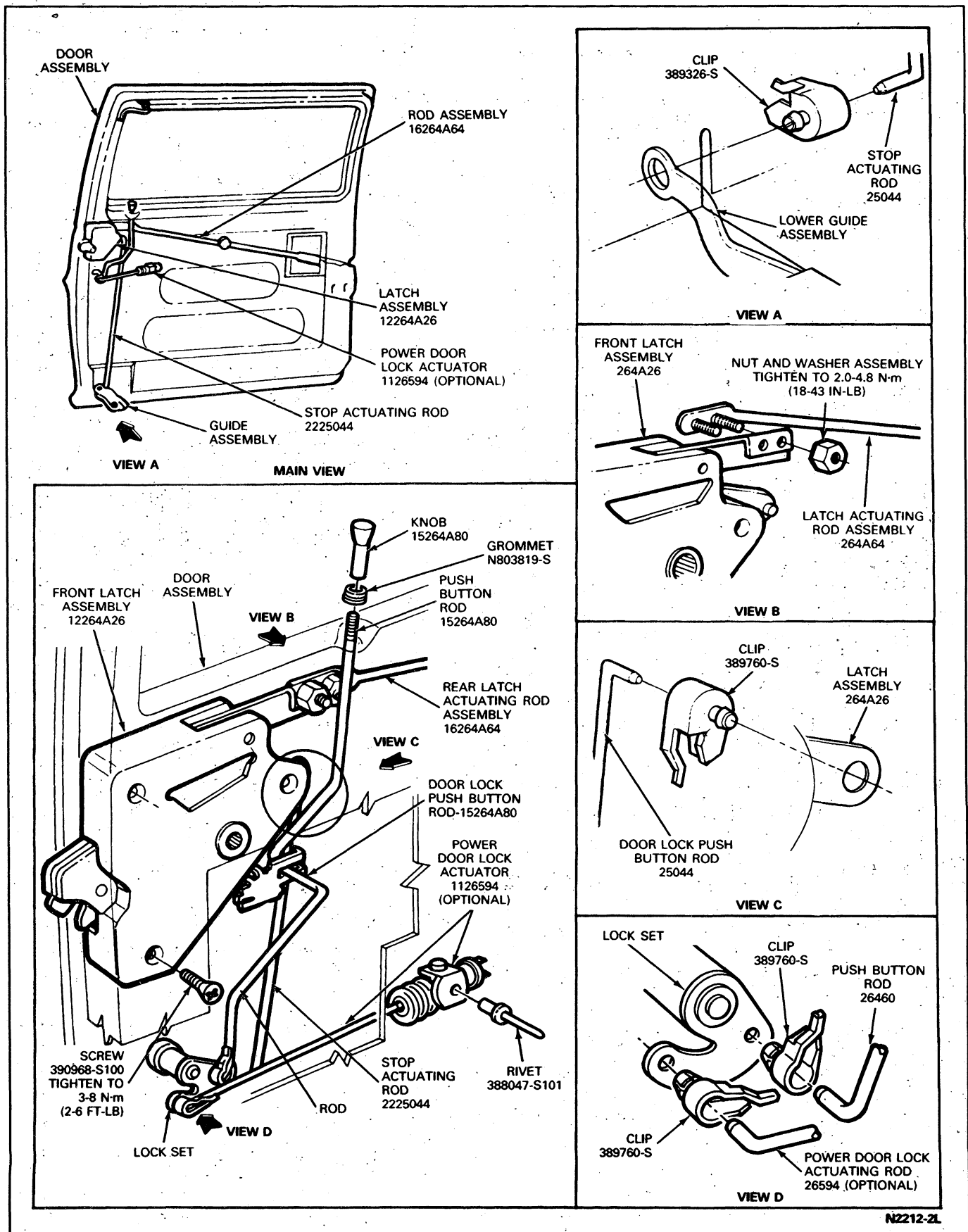


FIG. 4 Sliding Door—Latch and Rods—E-150—E-350

5. Connect the rod to the new lower guide stop arm and secure the retainer.
6. Position the guide assembly to the door and install the retaining screws.
7. Rotate the inside door handle forward to ensure proper releasing action of the stop.

### Door Latch—Front

#### Removal and Installation

1. Remove door trim panel. Refer to Section 45-03, Door Trim Panels. Also, remove inside handle attaching screw and inside handle and escutcheon (Fig. 5).
2. Remove outside door handle retainer. Slide outside door handle and shaft as an assembly out of the latch. **DO NOT REMOVE THE OUTSIDE DOOR HANDLE SCREW**
3. Remove the sleeve attaching screws and remove the sleeve from the latch.
4. Remove the rear latch actuating rod assembly from the rear latch (Fig. 1, View A).
5. Remove the door lock pushbutton rod from the lock cylinder and disengage it from the latch lever arm (Fig. 4, Views C and D, and Main View).
6. Remove the stop actuating rod from the front latch (Fig. 4, Main View).
7. Remove the three front latch retaining screws and disconnect the rear latch actuating rod from the latch.
8. Remove the front latch assembly through the access hole in the door.

9. Position the new latch assembly in the access hole opening and connect the rear latch actuating rod to the front latch.
10. Position the latch to the door and install the three retaining screws.
11. Connect the stop actuating rod to the front latch fork in the lock.
12. Position the pushbutton lock rod through the latch lever and connect the lock rod to the lock cylinder.
13. Position the sleeve to the latch assembly and install the retaining screws (Fig. 5).
14. Insert the outside handle assembly into the latch and install the handle retaining clip.
15. Connect the rear latch actuating rod to the rear latch assembly (Fig. 5, Main View). **The front latch must be in the full latched position and the rear latch must be in the secondary position before connecting the rear latch actuating rod to the rear latch assembly. Do not push or pull on the rod to make the hookup. Align the attaching holes by rotating the adjuster on the rear latch actuating rod.**
16. Check for proper latching operation before installing the door trim panel, escutcheon and inside door handle.

### Door Latch—Rear

#### Removal and Installation

1. Remove the door trim panel. Refer to Section 45-03, Door Trim Panels.

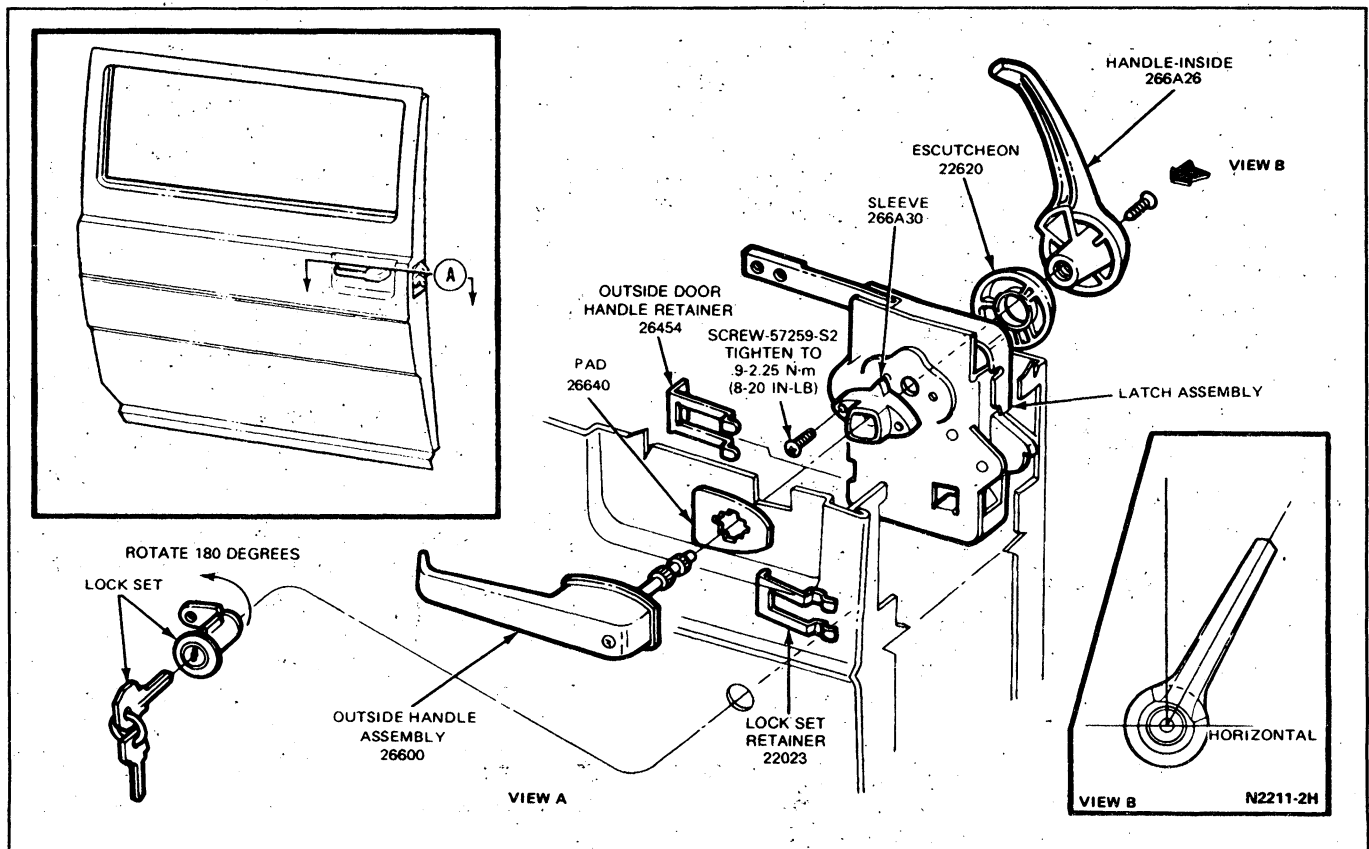


FIG. 5 Sliding Door—Lock and Latch—E-150—E-350

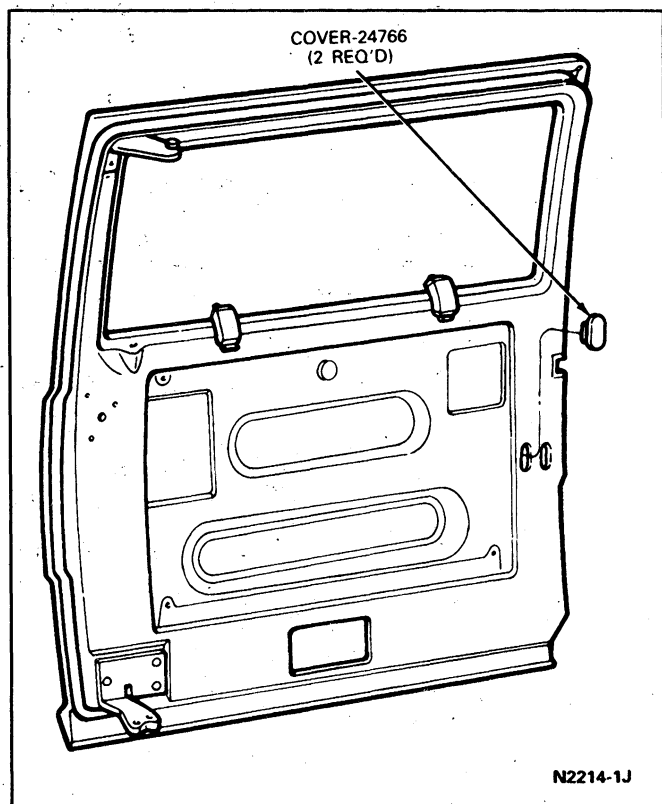


FIG. 6 Sliding Door—Access Hole Covers—E-150—E-350

2. Disconnect the actuating rod and retainer from the rear door latch arm (Fig. 1, View A).
3. Remove the three latch retaining screws and remove the latch from the door.
4. Position the new latch assembly into the door and install the three retaining screws.
5. Connect the actuating rod and retainer to the door latch arm. **The front latch must be in the full latched position and the rear latch must be in the secondary position before connecting the actuating rod and retainer to the door latch arm. Do not push or pull on the rod to make the hook-up. Align the attaching holes by rotating the adjuster on the front latch actuating rod.**
6. Check the latch operation and then, install the door trim panel. Refer to Adjustments if necessary.

### Door Hinge Assembly

#### Removal and Installation

1. Open and support the door assembly.
2. Remove the center track shield as outlined (Fig. 3, View B).
3. Remove the door trim panel and/or access hole covers, if so equipped (Fig. 6). Refer to Section 45-03, Door Trim Panels.
4. Mark the position of the hinge assembly to the door (Figs. 1 and 7).
5. Slide the hinge assembly to a position in line with the loading notches located in the center track. Remove the door from the track.

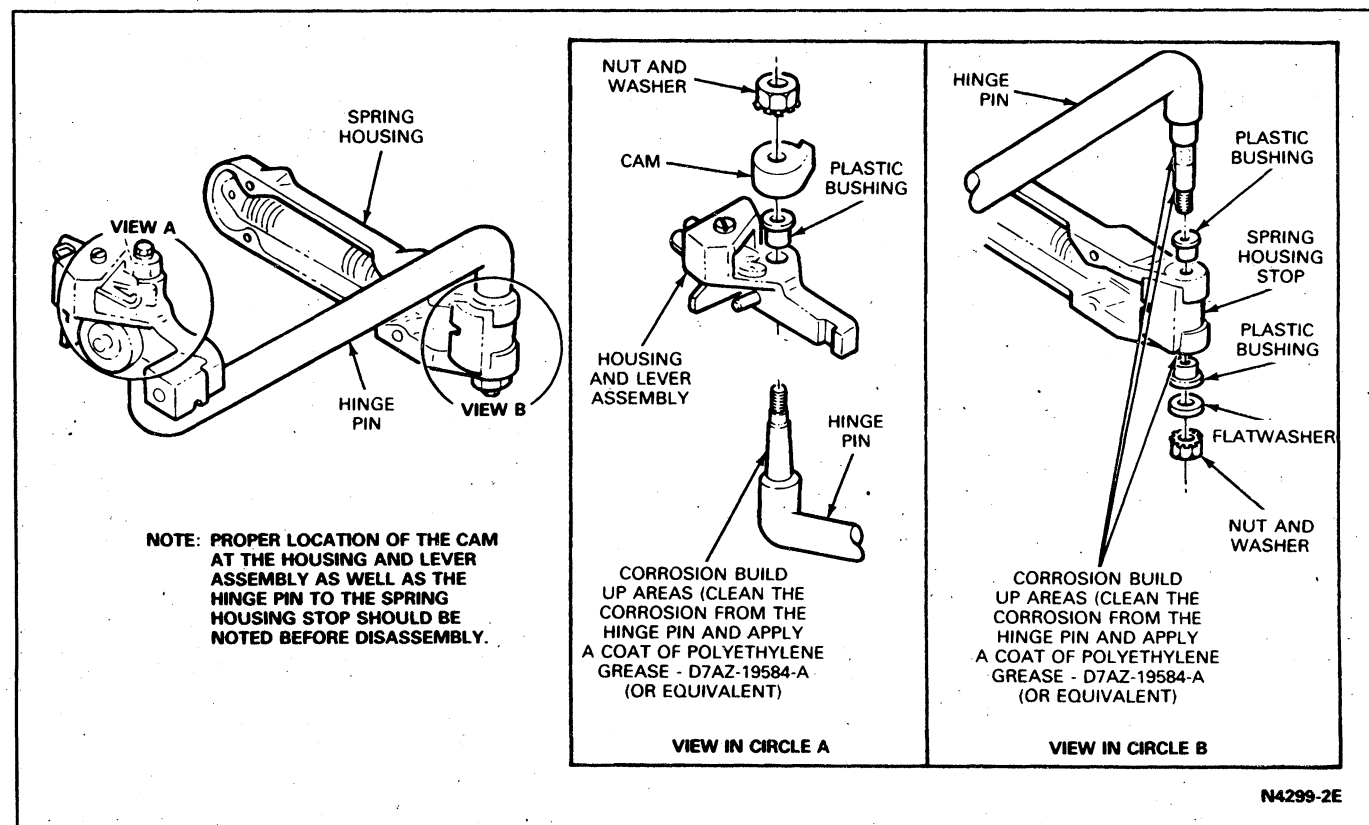


FIG. 7 Hinge Disassembled



6. Install the new hinge assembly through the loading notches in the center track. Position the hinge to the door.
7. Install the hinge retaining screws and check the operation of the door.
8. Then, install the trim panel and/or access hole covers. Refer to Section 45-03, Door Trim Panels.
9. Install the center track shield.

**Weatherstrips**

Refer to Section 44-06, Door Hinges, Checks and Weatherstrips.

**Striker—Front Latch****Removal and Installation**

1. Remove nine B-pillar trim panel screws.
2. Remove two striker bolts and transfer the shim(s) to the new striker (Fig. 3, View C).
3. Position the striker and install the two attaching bolts (snug). Adjust as necessary.
4. Install the B-pillar trim panel (nine screws).

# SECTION 44-11 Door Latches and Locks

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Latch Striker Adjustment .....	44-11-1	Left Rear Door Latch .....	44-11-8
Front Doors .....	44-11-1	Lock Cylinder .....	44-11-11
Rear Doors E-150—E-350 .....	44-11-1	Rear Door Latch—F-350 Crew Cab .....	44-11-3
Rear Side Door (E-150—E-350 with Side Hinged Doors) .....	44-11-1	Rear Side Cargo Door Latch .....	44-11-3
<b>REMOVAL AND INSTALLATION</b>		Remote Control Assembly—F-350 Crew Cab Rear Door .....	44-11-10
Door Inside Handle .....	44-11-11	Remote Control Assembly—Front Door .....	44-11-8
Door Outside Handle .....	44-11-11	Remote Control Assembly—Right Rear Door .....	44-11-10
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Front Side and Right Rear Cargo Doors—Outside Handles .....	44-11-11	<b>VEHICLE APPLICATION</b> .....	44-11-1
Front Side Cargo Door Latch .....	44-11-3		

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350 and Bronco.

## ADJUSTMENTS

### Latch Striker Adjustment

**CAUTION:** Do not cover up a poor door alignment with a latch striker adjustment.

#### Front Doors

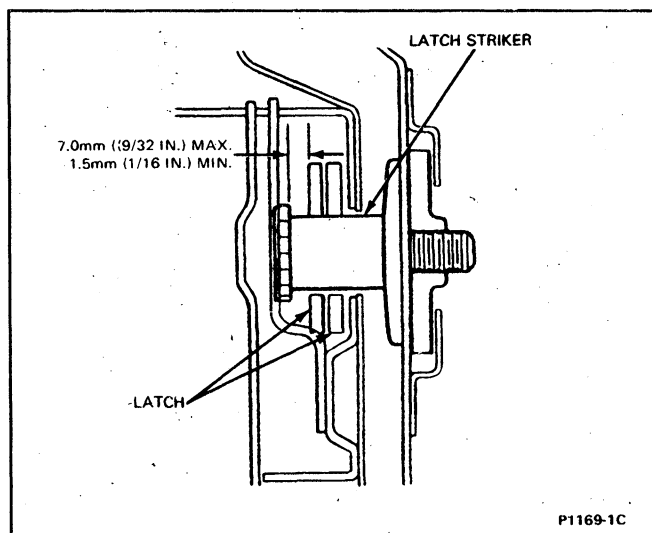
Use Torx Drive Bit Set D79P-2100-T or equivalent where required to loosen or tighten striker.

The striker pin can be adjusted laterally and vertically as well as fore and aft. The latch striker should not be adjusted to correct door sag. The latch striker should be shimmed to get the clearance shown in Fig. 1 between the latch striker and the latch. To check this clearance:

1. Clean the latch jaws and the striker area.
2. Apply a thin layer of dark grease such as Long-Life Lubricant C1AZ-19590-BA or equivalent to the latch striker.
3. As the door is closed and opened, a measurable pattern will result.
4. Move the striker assembly laterally to provide a flush fit with the door and body. Do not use more than two shims.
5. Tighten the striker to 33-45 N·m (24-33 ft-lb).

#### Rear Doors E-150—E-350

The back door latch strikers are adjusted inboard or outboard to obtain a flush fit of the doors with the body. To adjust the striker(s), loosen the two attaching screws and move the striker(s) as necessary to obtain the proper door fit. Tighten the two attaching screws. The striker should be shimmed to get the required clearance (Fig. 7, Views B And C). **Do not use more than two shims.**



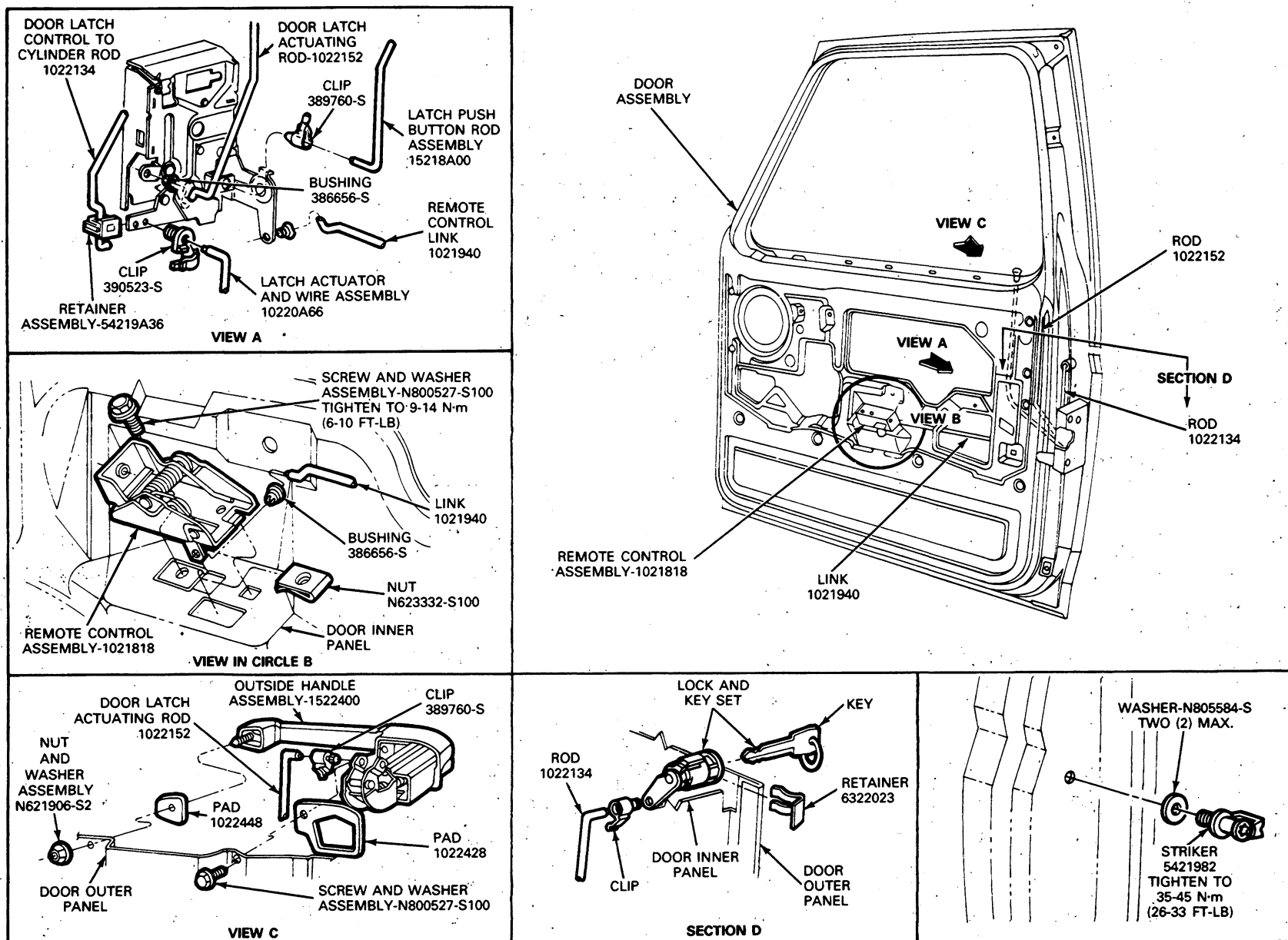
**FIG. 1 Latch Striker Adjustment—Typical Bronco, F-150—F-350 and E-150—E-350**

#### Rear Side Door (E-150—E-350 with Side Hinged Doors)

The rear side door latches (upper and lower) can be adjusted inboard or outboard to obtain a flush fit of the door with the body. To adjust the latch assemblies, loosen the two attaching screws and move the assemblies as necessary to obtain the proper door fit. Tighten the two attaching screws (Fig. 5).

## REMOVAL AND INSTALLATION

**Note:** Due to the conversion from single 90 degree Rod end shape to double 90 degree Rod end shape, it may be necessary to remove more parts than the instructions indicate. This action will allow more maneuverability of the Rod and ease the removal process.



N4607-2J

FIG. 2 Door Latch Installation—Bronco and F-150—F-350

## Front Door Latch

### Bronco and F-Series

#### Removal

1. Remove the trim panel and watershield from the door. Refer to Section 45-03, Door Trim Panels.
2. Disconnect rods from handle and lock cylinder if necessary, and from remote control assembly (Fig. 2).
3. Remove the latch assembly attaching screws and remove the latch from the door.

#### Installation

1. Install the rod retaining clips in the new latch assembly. Rods should be attached to latch before latch installation.
2. Position the latch in the door and install the latch attaching screws.
3. Connect the rods to the handle, lock cylinder and remote control. Check the operation of the latch.
4. Install the watershield and trim panel on the door. Refer to Section 45-03, Door Trim Panels.

### E-150—E-350

#### Removal

1. Remove the door inside handle. If equipped with door trim panels, remove the inside handle cup and window regulator handle. If equipped with power door locks, refer to Section 44-16, Power Door Locks.
2. Remove the access cover plate or door trim panel and the watershield. Refer to Section 45-03, Door Trim Panels.
3. Remove the door glass rear run. Refer to Section 42-04, Front Door Window Glass and Mechanisms.
4. Disconnect rods from handles and lock cylinder.
5. Remove the three screws attaching the latch to the door and remove latch assembly.

#### Installation

1. Connect the control rods and link to the door latch (Fig. 3, View A).
2. Position the door latch to the door and install the three attaching screws.
3. Install the door glass rear run.
4. Install the watershield and door trim panel or access cover plate. Refer to Section 45-03, Door Trim Panels.
5. Install the door inside handle cup (if equipped with trim panel), inside handle, and window regulator handle.

## Front Side Cargo Door Latch

### E-150—E-350 with Hinged Side Doors

#### Removal

1. Remove the door access cover or trim panel and watershield, if so equipped. Refer to Section 45-03, Door Trim Panels.
2. Remove the two nuts attaching the door inside handle and remove handle (Fig. 4).

3. Remove the three remote control bracket attaching screws. Disconnect the remote control link. Remove the remote control and bracket as an assembly.
4. Unscrew and remove the door lock pushbutton knob (Fig. 4).
5. Disconnect the pushbutton rod from the door latch.
6. Disconnect the door outside handle rod from the outside handle (Fig. 4).
7. Remove the three latch attaching screws and remove latch from door.

#### Installation

1. Transfer the rods and bushings to the new latch assembly if the latch assembly is to be replaced.
2. Position the latch in the door and insert the pushbutton rod through the pushbutton hole. Install the three latch attaching screws. Tighten the three screws 4-8 N·m (3-6 ft-lb).
3. Connect the outside handle rod to the door outside handle.
4. Connect the pushbutton rod to the door latch.
5. Connect the link to the remote control. Position the remote control and bracket to the door inner panel and install the attaching screws.
6. Install the door inside handle and the lock pushbutton.
7. Install the watershield and trim panel or access cover, if so equipped. Refer to Section 45-03, Door Trim Panels.

## Rear Door Latch—F-350 Crew Cab

#### Removal

1. Remove the trim panel and watershield from the door. Refer to Section 45-03, Door Trim Panels.
2. Disconnect rods from handle and lock cylinder if necessary, and from remote control assembly (Fig. 5, View A).
3. Remove the latch assembly attaching screws and remove the latch from the door.

#### Installation

1. Install the rod retaining clips in the new latch assembly. Rods should be attached to latch before latch installation.
2. Position the latch in the door and install the latch attaching screws.
3. Connect the rods to the handle, lock cylinder and remote control. Check the operation of the latch.
4. Install the watershield and trim panel on the door. Refer to Section 45-03, Door Trim Panels.

## Rear Side Cargo Door Latch

### E-150—E-350 with Hinged Side Doors

#### Removal

1. Remove the inside handle from the remote control shaft.
2. Disconnect the lower latch rod from the remote control (Fig. 6, View A).

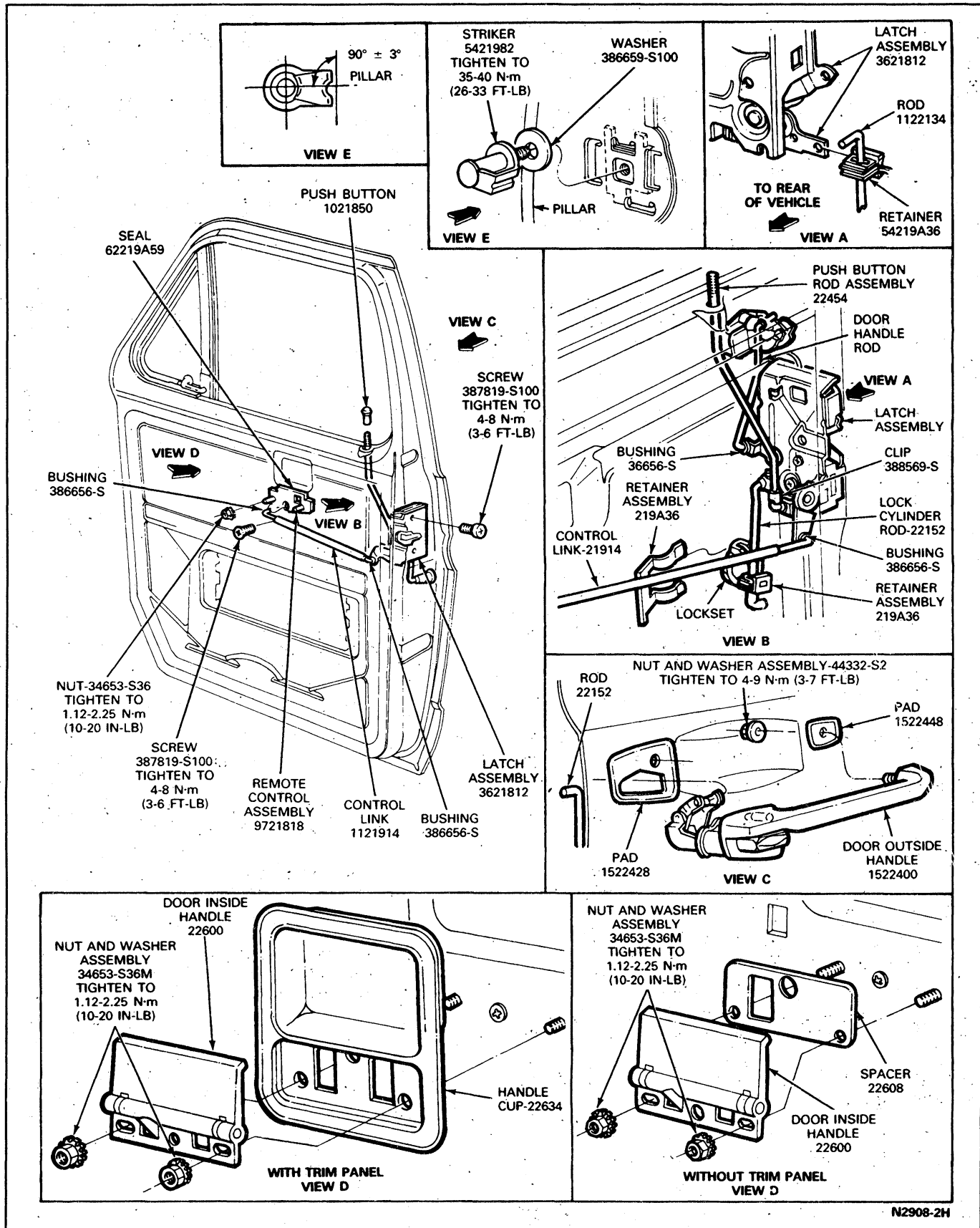


FIG. 3 Front Door Latch and Remote Control Installation—E-150—E-350 w/o Power Door Locks

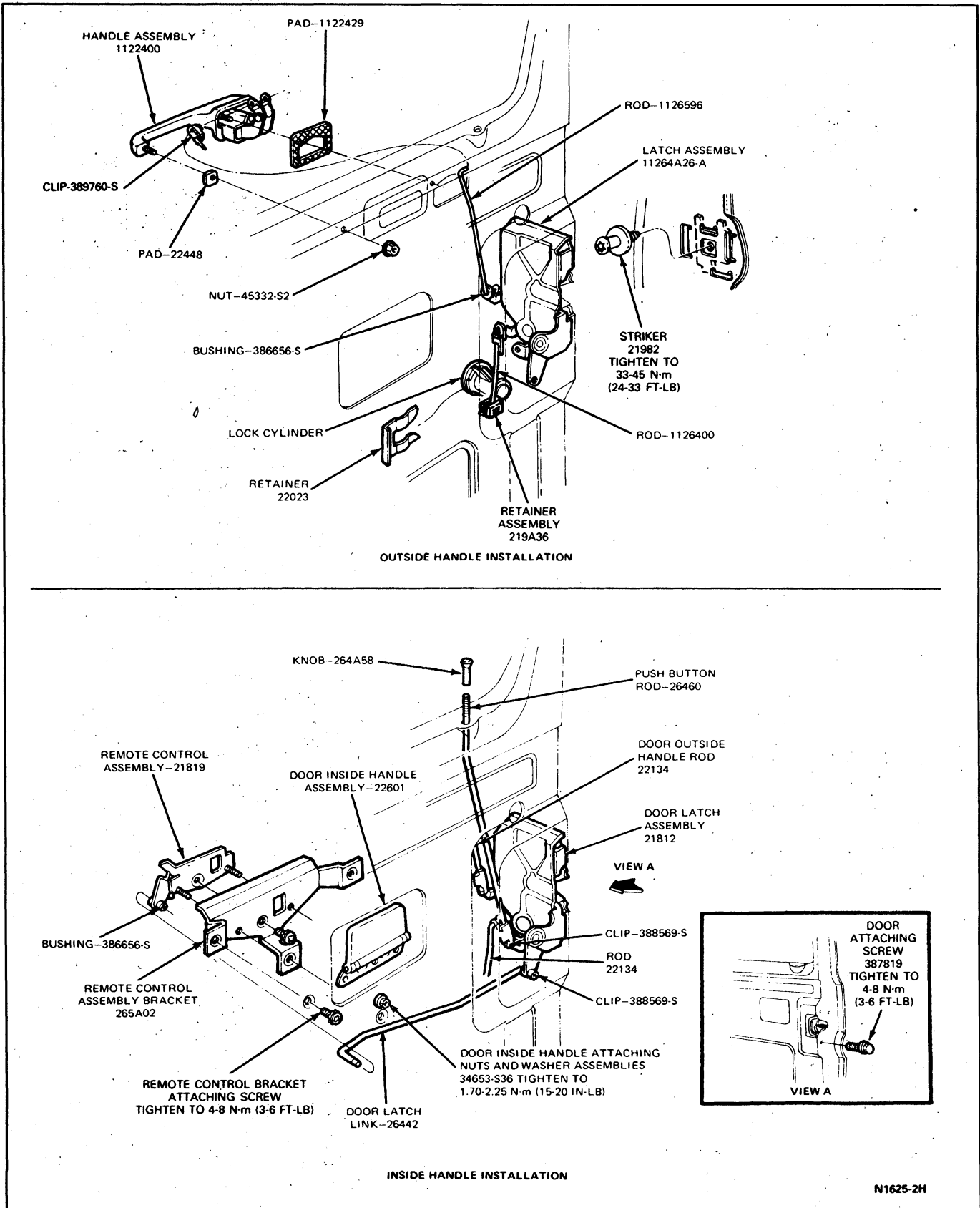


FIG. 4 Front Side Cargo Door Latch Installation—E-150—E-350

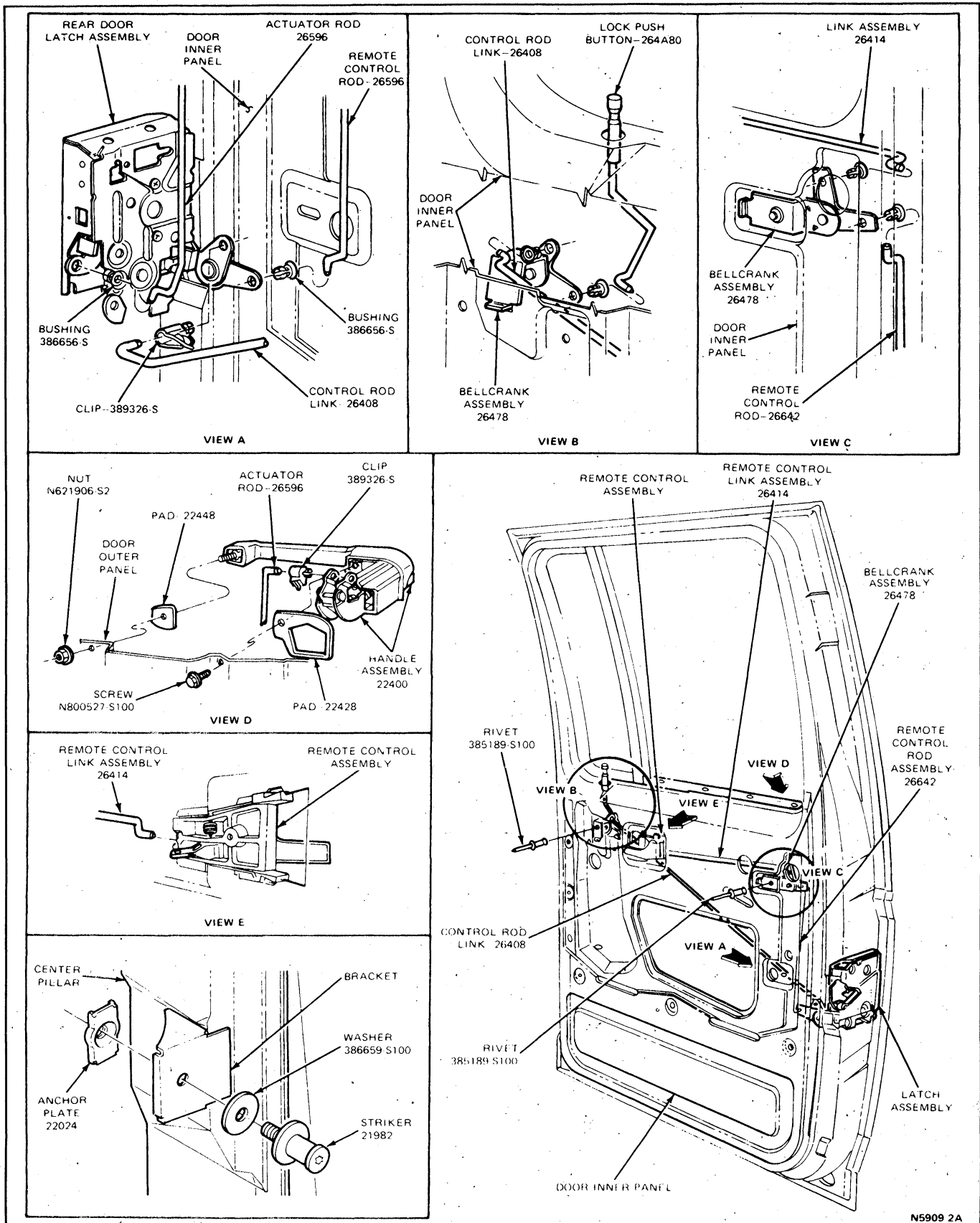
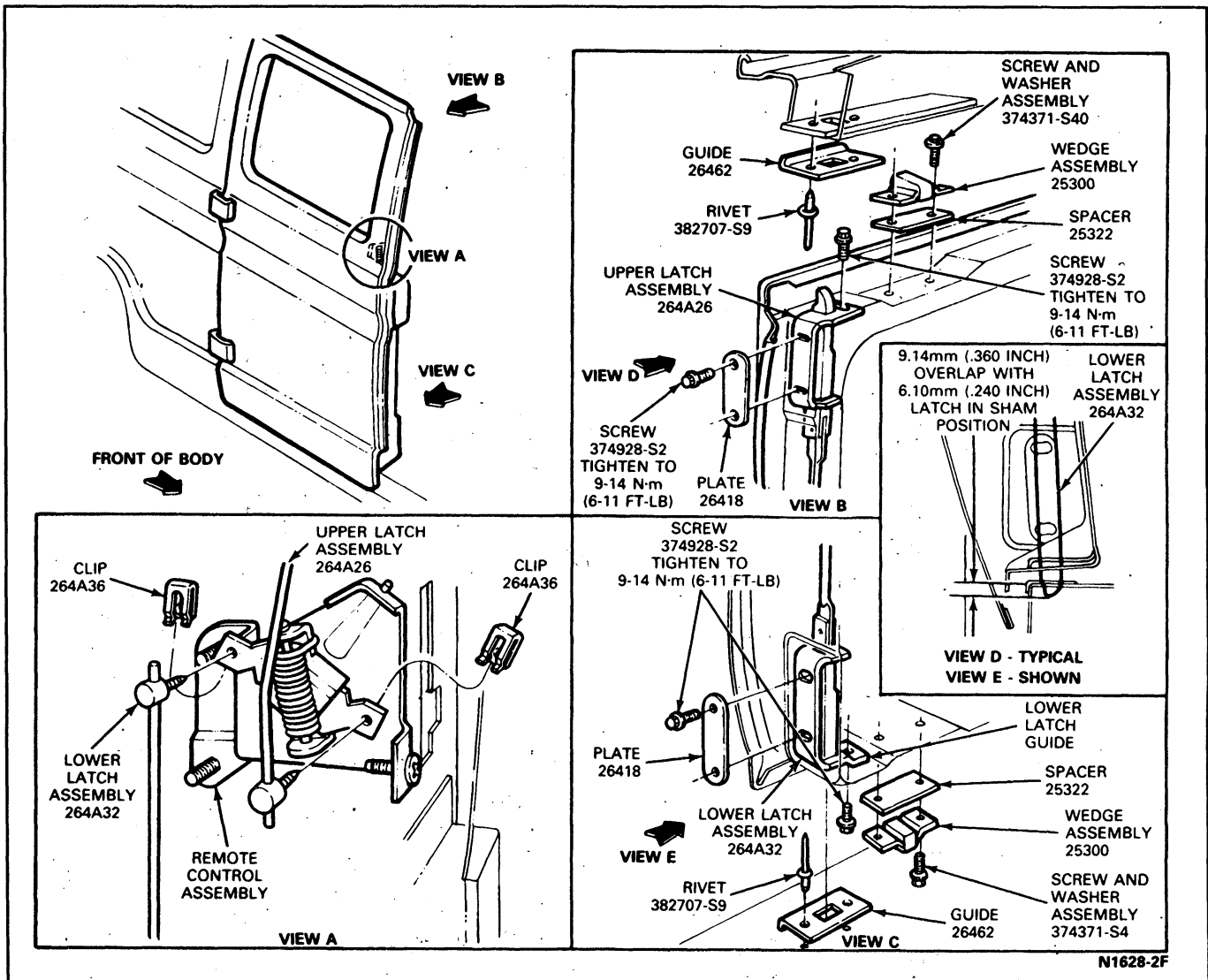


FIG. 5 Rear Door Latch and Remote Control Installation—F-350 Crew Cab



**FIG. 6 Rear Side Cargo Door Latch Installation—E-150—E-350**

3. Remove three screws attaching the lower latch guide to the bottom of the door (Fig. 6, View C). Remove the lower latch assembly from the door.
4. Remove three screws attaching the remote control to the door (Fig. 7, View A).
5. Remove three screws attaching the upper latch guide to the top of the door (Fig. 6, View B). Remove the upper latch assembly and remote control from the door.
6. Disconnect the upper latch assembly from the remote control.
5. Install three screws attaching the remote control to the door (Fig. 7, View A).
6. Install the inside handle on the remote control shaft.
7. Adjust the door for a snug fit against the weatherstrip. This is done by loosening the latch guide attaching screws and moving the latch assembly inboard or outboard as required. Then, tighten the latch guide attaching screws.

#### Installation

1. Assemble the upper latch assembly to the remote control (Fig. 6, View B).
2. Position the upper latch assembly and remote control to the door. Install three screws attaching the upper latch guide to the top of the door.
3. Position the lower latch assembly in the door and connect the lower latch rod to the remote control (Fig. 6, View C).
4. Install three screws attaching the lower latch guide to the door.

#### Right Rear Door Latch

**E-150—E-350**

#### Removal

1. Remove the door trim panel and watershield, if so equipped. Refer to Section 45-03, Door Trim Panels.
2. To remove the upper latch, remove the three screws attaching the upper latch to the door (Fig. 8, View B).
3. Disengage the lock rod clip, remove the latch rod from the upper latch, and remove the upper latch from the door.



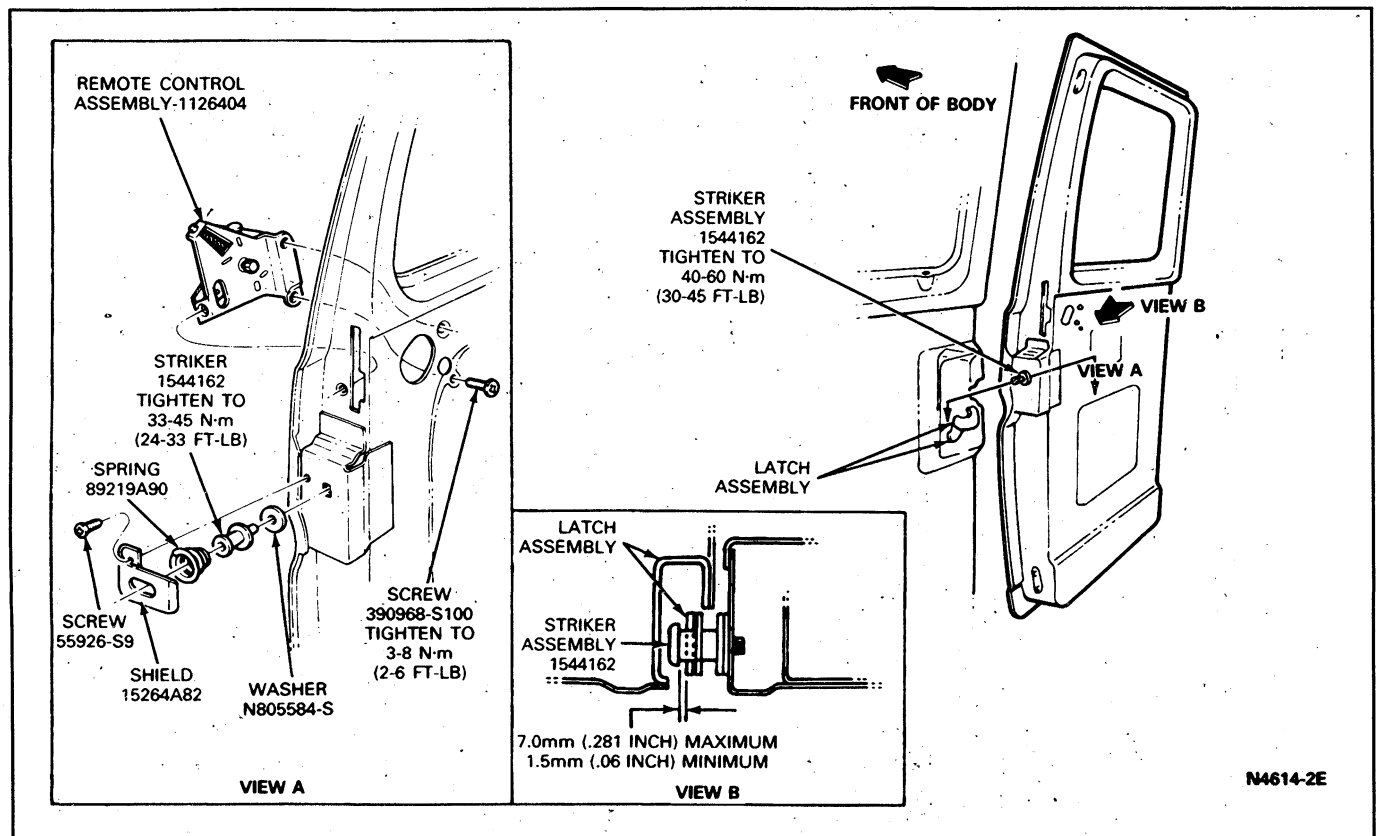


FIG. 7 Rear Side and Left Rear Door Remote Control Door Latch and Striker—E-150—E-350

- To remove the lower latch, remove the four latch attaching screws and disengage the latch rod from the latch. Remove the latch from the door (Fig. 8, View C).

#### Installation

- To install the lower latch, connect the latch rod and bushing to the latch. Position the latch to the door and install the four attaching screws.
- To install the upper latch, position the latch to the door and install the three attaching screws.
- Connect the latch rod clip and rod to the latch (Fig. 8).
- Check the operation of the latches and adjust the strikers, if necessary. Refer to Latch Striker Adjustments.
- Install the watershield and door trim panel, if so equipped. Refer to Section 45-03, Door Trim Panels.

#### Left Rear Door Latch

##### E-150—E-350

#### Removal and Installation

- Remove the door trim panel and watershield, if so equipped.
- Remove the four latch attaching screws and remove the latch from the door (Fig. 9).
- Position the latch to the door and install the four attaching screws.

- Install the watershield and door trim panel, if so equipped. Refer to Section 45-03, Door Trim Panels.

#### Remote Control Assembly—Front Door

##### F-Series and Bronco

#### Removal and Installation

- Remove the door trim panel and watershield. Refer to Section 45-03, Door Trim Panels.
- Remove the screws attaching the remote control to the door inner panel, and remove the remote control.
- Disconnect the latch remote control link from the remote control (Fig. 2, View A).
- Transfer the rod clip to the new remote control, if the remote control is to be replaced.
- Position the remote control to the door inner panel and connect the link to the remote control.
- Install the remote control attaching screw.
- Check the remote control and latch operation.
- Install the watershield and door trim panel. Refer to Section 45-03, Door Trim Panels.

##### E-150—E-350

#### Removal and Installation

- Remove the door inside handle, inside handle cup (if so equipped) and window regulator handle.
- Remove the access cover plate and watershield from the door inner panel.

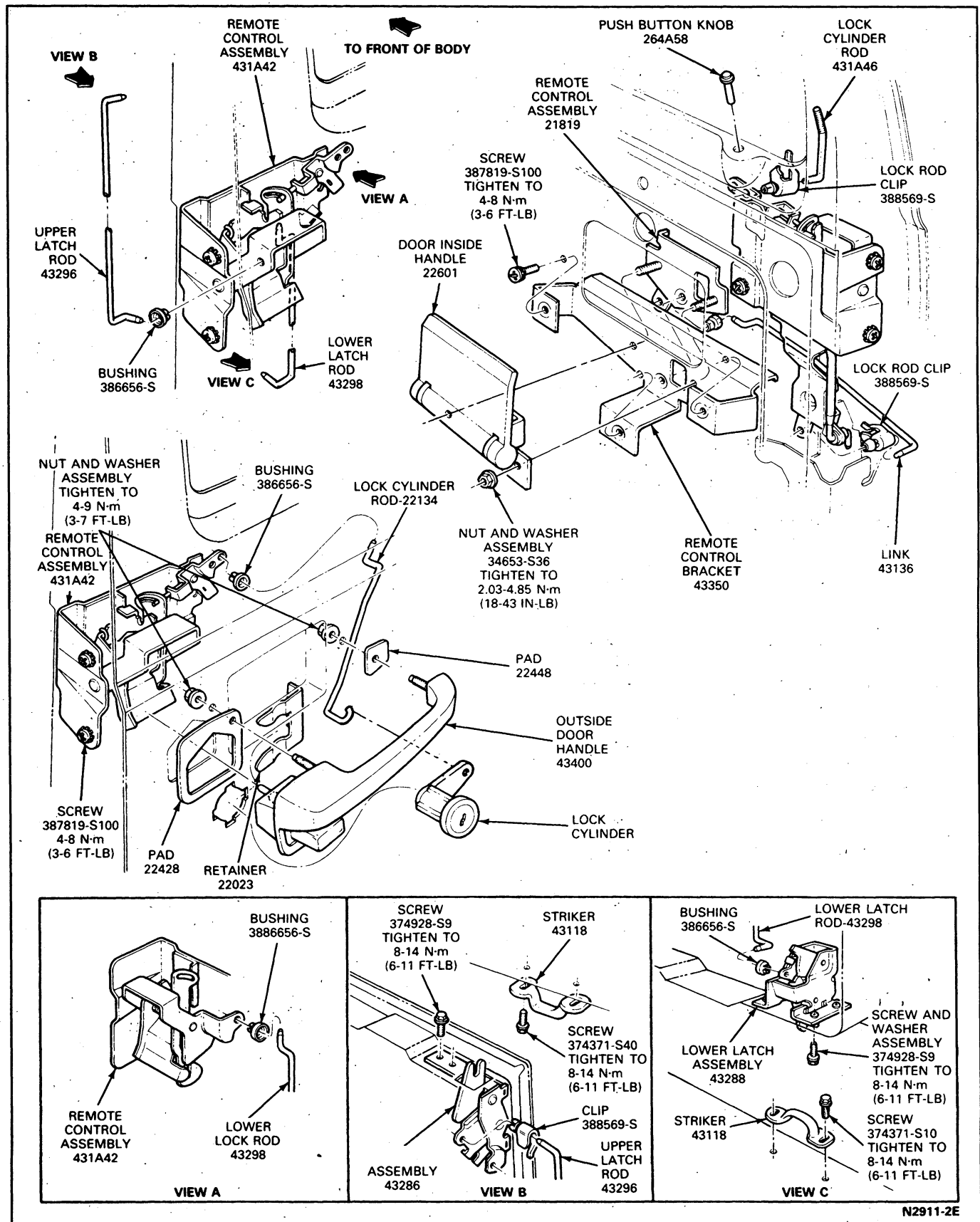


FIG. 8 Right Rear Door Latch and Remote Control Installation—E-150—E-350

3. Remove the screw attaching the remote control to the door inner panel (Fig. 3).
4. Disengage the link from the remote control and remove the remote control from the door.
5. Transfer the bushing to the new remote control.
6. Connect the link to the remote control. Install the remote control to the door inner panel with the attaching screws.
7. Install the watershield and access cover plate.
8. Install the window regulator handle, inside handle cup (if so equipped), and door inside handle.

### Remote Control Assembly—F-350 Crew Cab Rear Door

#### Removal

1. Remove the two screws retaining armrest to door inside panel. Remove the screw retaining window regulator handle to door.
2. Remove inside door handle trim cup.
3. Remove door trim panel and watershield, if so equipped. Refer to Section 45-03, Door Trim Panels.
4. Push tabs on remote control assembly together and slide assembly forward (Fig. 5, View E).
5. Disconnect link rod from remote control assembly by rotating remote control clockwise. Remove remote control assembly from door.

#### Installation

1. Install link rod to remote control assembly.
2. Slide remote control assembly into slot in door inner panel until retaining tabs are engaged.
3. Install door trim panel and watershield, if so equipped. Refer to Section 45-03, Door Trim Panels.
4. Install door handle trim cup with one screw. Install window regulator handle with one screw.
5. Install armrest with two screws.

### Remote Control Assembly—Right Rear Door E-150—E-350 (Without Door Inside Handle)

#### Removal

1. Remove the door trim panel and watershield, if so equipped. Refer to Section 45-03, Door Trim Panels.
2. Disconnect the lock cylinder rod from the lock cylinder (Fig. 8).
3. Remove the three screws attaching the remote control assembly to the door (Fig. 8).
4. Disconnect the upper latch rod from the upper latch (Fig. 8, View B). Disconnect the upper latch rod from the remote control assembly.
5. Disconnect the lower latch rod from the remote control assembly, and remove the assembly from the door.

#### Installation

1. Transfer the lock cylinder rod and rod bushings to the new remote control assembly.
2. Position the remote control assembly into the door and connect the lower latch rod to the assembly.
3. Connect upper latch rod to remote control assembly and to the upper latch (Fig. 8, View B).

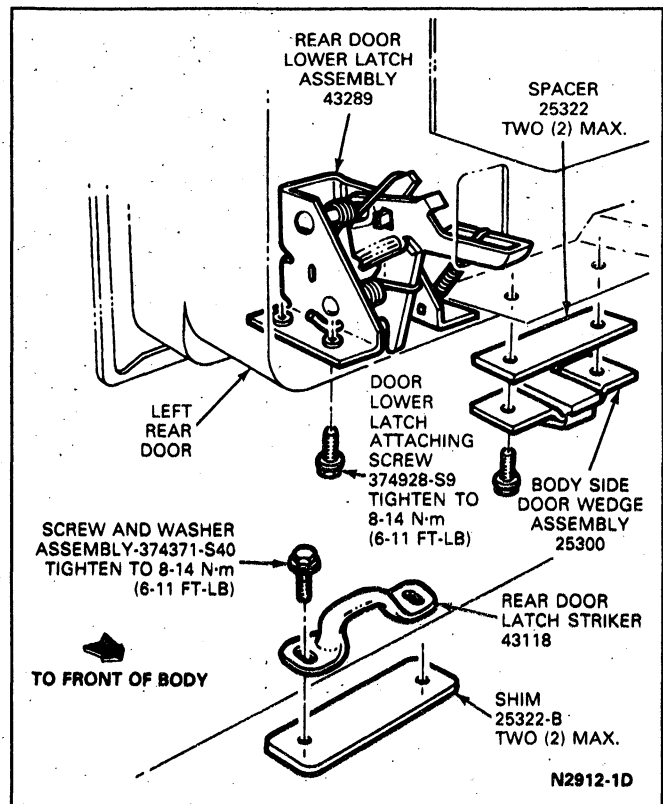


FIG. 9 Left Rear Door Latch—E-150—E-350

4. Position remote control assembly to door inner panel and install three attaching screws.
5. Connect the lock cylinder rod to the lock cylinder (Fig. 8).
6. Install the watershield and door trim panel, if so equipped. Refer to Section 45-03, Door Trim Panels.

### E-150—E-350 (With Door Inside Handle)

#### Removal

1. Remove the two nuts retaining the door inside handle to the handle remote control and remove the handle.
2. Remove the door trim panel and watershield, if so equipped. Refer to Section 45-03, Door Trim Panels.
3. Disconnect the door handle remote control link from the remote control (Fig. 8).
4. Remove the three screws attaching the door handle remote control bracket to the door inner panel. Remove the door handle remote control, bracket, and link from the door.
5. Unscrew and remove the door lock pushbutton (Fig. 8).
6. Disconnect the lock cylinder rod from the lock cylinder.
7. Remove the three screws attaching the remote control assembly to the door (Fig. 8).
8. Disconnect the upper latch rod from the upper latch (Fig. 8). Disconnect the upper latch rod from the remote control assembly.
9. Disconnect the lower latch rod from the remote control assembly and remove the assembly from the door.

**Installation**

1. Transfer the door lock push rod, lock cylinder rod, and rod bushings to the new remote control assembly.
2. Position the remote control assembly into the door, and connect the lower latch rod to the assembly.
3. Connect the upper latch rod to the remote control assembly and upper latch (Fig. 8).
4. Place the remote control assembly in position and insert the door lock pushbutton rod through the pushbutton hole (Fig. 8). Install the three remote control assembly attaching screws.
5. Connect the lock cylinder rod to the lock cylinder (Fig. 8).
6. Screw the door lock pushbutton on the pushbutton rod.
7. Position the door inside handle remote control and bracket to the door inner panel. Install the three attaching screws (Fig. 8).
8. Connect the inside handle remote control link to the remote control assembly.
9. Install the watershield and door trim panel, if so equipped. Refer to Section 45-03, Door Trim Panels.
10. Install the door inside handle.

**Lock Cylinder****Removal and Installation**

When a lock cylinder is replaced, both door lock cylinders should be replaced in a set. This will eliminate carrying an extra key which will fit only one lock. If a key is to be replaced, the new key code number is stamped on a metal tag attached to the key.

1. Roll the window to the up position.
2. Remove the access hole cover and/or trim panel and pull away the watershield, if so equipped.
3. Disconnect the lock actuating rod from the lock control link clip.
4. Slide the lock cylinder retainer away from the lock cylinder (Figs. 2, 3, 4 and 8).
5. Remove the lock cylinder.
6. Insert the lock cylinder in the door and connect the lock cylinder retainer.
7. Connect the lock actuating rod to the lock control link clip.
8. Install the watershield. Using Rubber Cement 8A-19552-B or equivalent, cement the top and/or side edges of the watershield to the inner surface of the inner panel.
9. Install the access hole cover and/or trim panel. Refer to Section 45-03, Door Trim Panels.

**Door Inside Handle****F-150—F-350 and Bronco (except F-350 Crew Cab Rear Door)****Removal and Installation**

To remove the door inside handle, remove one screw and remove the handle. To install, position handle on shaft and secure with set screw.

**F-350 Crew Cab—Rear Door**

The door inside handle is an integral part of the remote control assembly. Refer to Crew Cab Rear Door Remote Control Removal and Installation.

**E-150—E-350****Removal and Installation**

The door inside handle is attached to the remote control with two nut and washer assemblies (Fig. 3). Remove the nut and washer assemblies to remove the inside handle. An inside handle cup is used on E-150—E-350 models with door trim panels. The cup can be removed by pulling it off the remote control studs.

**Door Outside Handle****Bronco, F-150—F-350 and E-150—E-350****Removal and Installation**

1. Remove the trim panel and watershield from the door. Refer to Section 45-03, Door Trim Panels.
2. Disconnect the latch actuating rod from the handle link connector (Fig. 2).
3. Remove two nuts retaining outside handle (one nut and one screw for Bronco and F-150—F-350).
4. Remove handle and pads from door.
5. Attach actuator rod and pads to new handle.
6. Install two retaining nuts (one nut and one screw for Bronco and F-150—F-350).
7. Install door trim panel and watershield. Refer to Section 45-03, Door Trim Panels.
8. Check operation.

**Front Side and Right Rear Cargo Doors—Outside Handles****E-150—E-350****Removal and Installation**

1. Remove the door trim panel and watershield, if so equipped. Refer to Section 45-03, Door Trim Panels.
2. Remove the two nut and washer assemblies attaching the outside handle to the door (Fig. 8).
3. Remove the outside handle and pads from the door.
4. Position the pads and outside handle to the door and install the two screw and washer assemblies.
5. Install the watershield and door trim panel, if so equipped. Refer to Section 45-03, Door Trim Panels.

**SPECIFICATIONS****SPECIAL SERVICE TOOL**

Tool No.	Description
D79P-2100-T	"Torx" Drive Bit Set

CN5260-1B

# SECTION 44-16 Power Door Locks

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION (Cont'd)	
E-150—E-350 .....	44-16-1	Electric Door Lock Actuator Motor .....	44-16-3
F-150—F-350 and Bronco .....	44-16-1	SPECIAL SERVICE TOOLS .....	44-16-8
DIAGNOSIS AND TESTING		TESTING	
Diagnosis Guides .....	44-16-2	Motor .....	44-16-1
REMOVAL AND INSTALLATION		Switch .....	44-16-3
Door Lock Control Switch .....	44-16-4	VEHICLE APPLICATION .....	44-16-1
Door Lock Relay .....	44-16-4		

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350 and Bronco.

## DESCRIPTION AND OPERATION

### E-150—E-350

The power door lock control system uses electric switches controlled by push buttons mounted on the front door trim panels. Relays direct current to the door lock actuator motors to lock or unlock the doors.

To lock the doors, push firmly on either front door LOCK push button. Sliding cargo door and rear doors must be closed for contact buttons to function. To unlock the doors from inside the vehicle, push the UNLOCK button on the door trim panel-mounted switches.

The key will not lock or unlock all doors at the same time from outside the vehicle. The key inserted into the door lock can only be used to lock or unlock each individual door.

The power door lock control system includes contact buttons at the side cargo door and key-locked rear door. The contact buttons provide an electrical link for the operation of the lock actuator motors in the remote doors.

If electrical connections to the contact buttons are reversed, the door(s) will lock when the switch is moved to UNLOCK and open when the switch is moved to LOCK.

Two power contact buttons are installed in the B-pillar, the D-pillar, the side doors and rear door (Fig. 1).

The power contact buttons only transmit electrical power to the lock actuators when the two pairs of buttons are in good contact.

Power door locks are available on the following models:

- Cutaway models, power locks on driver and passenger doors.
- Vans and Club Wagons, power locks on all doors. All doors can be locked or unlocked by pushing on either driver or passenger lock button but not the side or rear door button.

### F-150—F-350 and Bronco

Refer to Fig. 7.

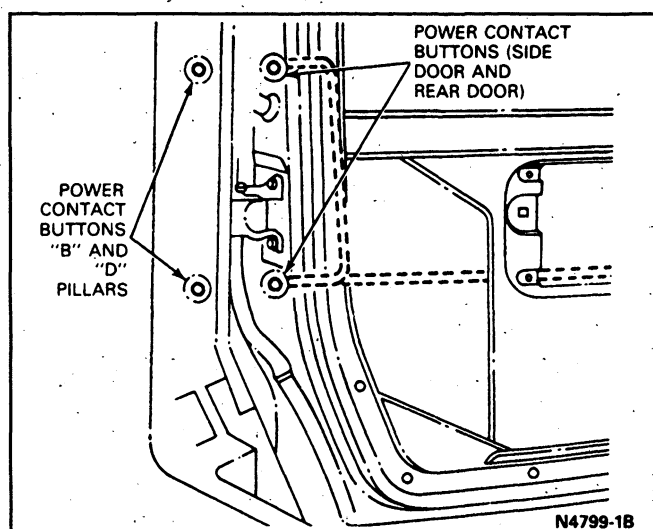


FIG. 1 Power Contact Buttons

The power door lock control system uses electric rocker-type switches located in the door trim panel.

Push the door lock switch to lock or unlock the door as desired.

The key inserted into the door lock can only be used to lock or unlock each individual door, from outside the vehicle.

## DIAGNOSIS AND TESTING

Refer to the Diagnosis Guide for power door lock diagnosis.

## TESTING

### Motor

Apply 12 volts directly to one terminal of the motor's (actuator) connector and ground the other terminal (Figs. 2, 3 and 4). The motor (actuator) should finish its travel in less than one second. Reverse the polarity for opposite travel.

Using a Rotunda Digital Volt-Ohm Meter 007-00001 or equivalent, the motor current draw (stall test), should not exceed 6.2 amps. Reverse the power and ground leads to the connector and re-test.

## Diagnosis Guides

CONDITION	POSSIBLE CAUSE	RESOLUTION
All door locks do not work.	<ol style="list-style-type: none"> <li>1. Malfunctioning circuit breaker.</li> <li>2. Open or shorted circuit.</li> <li>3. Malfunctioning switch.</li> <li>4. Open ground circuit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check circuit breaker. Replace if necessary. Refer to "Fuses &amp; Circuit Breakers", Section 34-31 for location.</li> <li>2. Check wiring and connections between circuit breaker and door lock switches. Service if necessary.</li> <li>3. Test switch. Refer to Testing in this Section. Replace if necessary.</li> <li>4. Check ground circuit from LH switch. Repair if necessary.</li> </ol>
Locks do not work in below freezing weather.	Frozen door latch or linkage.	Bring vehicle into heated garage to allow lock system to thaw. Verify that all locks now work. Using Multi-Purpose Grease Spray D7AZ-19584-AA or equivalent, spray into latch opening and manually cycle ten times. It may be necessary to remove door trim panel to lubricate entire latch and linkage system.
All locks work from one switch only.	<ol style="list-style-type: none"> <li>1. Open or shorted circuit.</li> <li>2. Malfunctioning switch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check wiring and connections between circuit breaker and inoperative switch. Service if necessary.</li> <li>2. Test switch. Refer to Testing in this Section. Replace if necessary.</li> </ol>
Door locks operate one way only.	Open ground circuit.	Check ground circuit from LH switch. Service if necessary.
Locks work intermittently.	<ol style="list-style-type: none"> <li>1. Loose connections.</li> <li>2. Poor ground at LH switch.</li> <li>3. Malfunctioning switch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check connectors. Tighten if necessary.</li> <li>2. Check ground circuit from left hand switch. Service if necessary.</li> <li>3. Test switch. Refer to Testing in this Section. Replace if necessary.</li> </ol>
One door lock does not work.	<ol style="list-style-type: none"> <li>1. Latch or linkage binding.</li> <li>2. Open or shorted circuit.</li> <li>3. Malfunctioning actuator.</li> </ol>	<ol style="list-style-type: none"> <li>1. Using Multi-Purpose Grease Spray D7AZ-19584-AA or equivalent, spray into latch opening and manually cycle ten times. Check for interference around night latch and all linkage.</li> <li>2. Check for voltage at actuator connector, operating switch in both positions. Service circuit if necessary.</li> <li>3. Test actuator. Refer to Testing in this Section. Replace if necessary.</li> </ol>
Door locks work with engine running only.	<ol style="list-style-type: none"> <li>1. Low charge in battery.</li> <li>2. Loose or corroded connections.</li> <li>3. Latch or linkage binding.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test battery. Refer to Section 31-02, Batteries. Charge if necessary.</li> <li>2. Check wiring and connections. Service if necessary.</li> <li>3. Using Multi-Purpose Grease Spray D7AZ-19584-AA or equivalent, spray into latch opening and manually cycle ten times. Check for interference around night latch and all linkage.</li> </ol>

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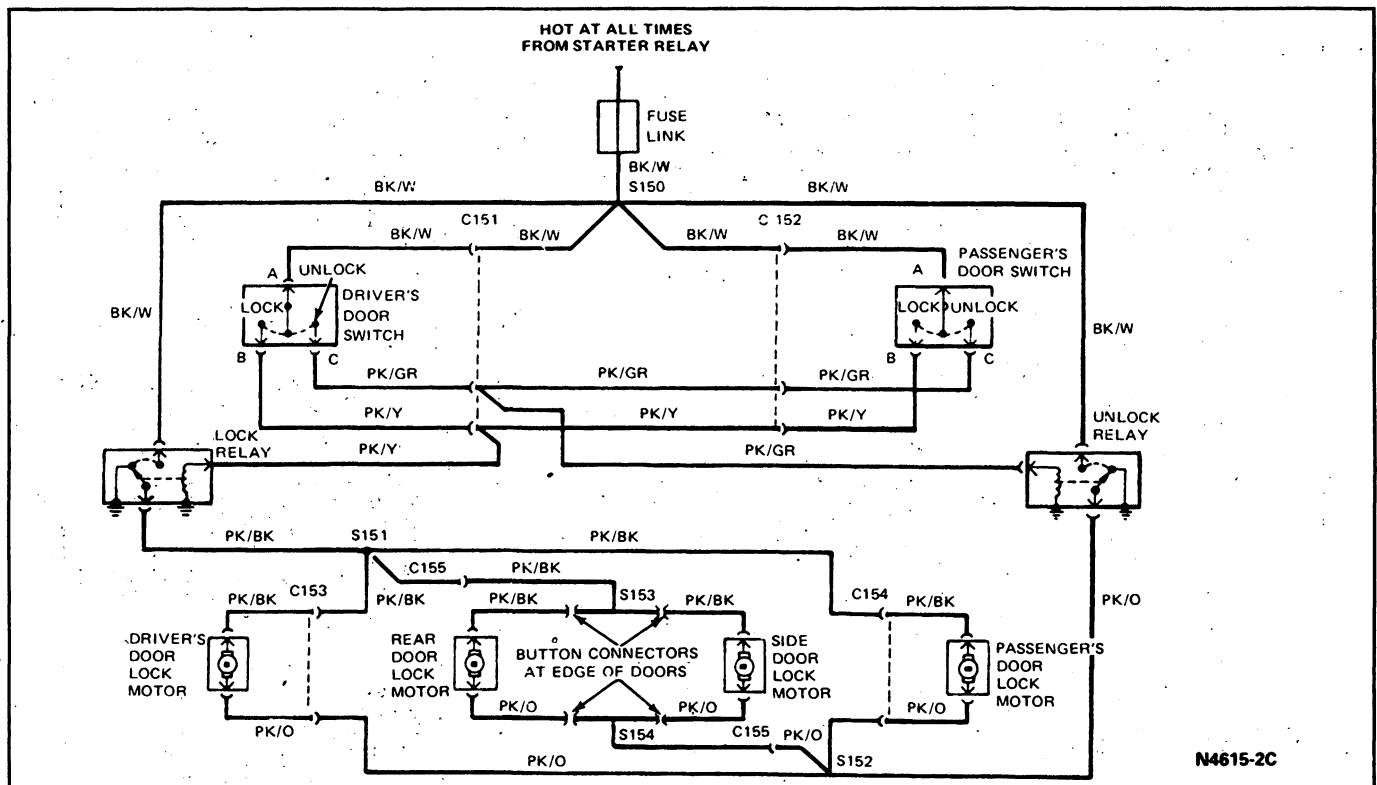


FIG. 2 Power Door Lock Electrical Schematic—E-150—E-350 Shown

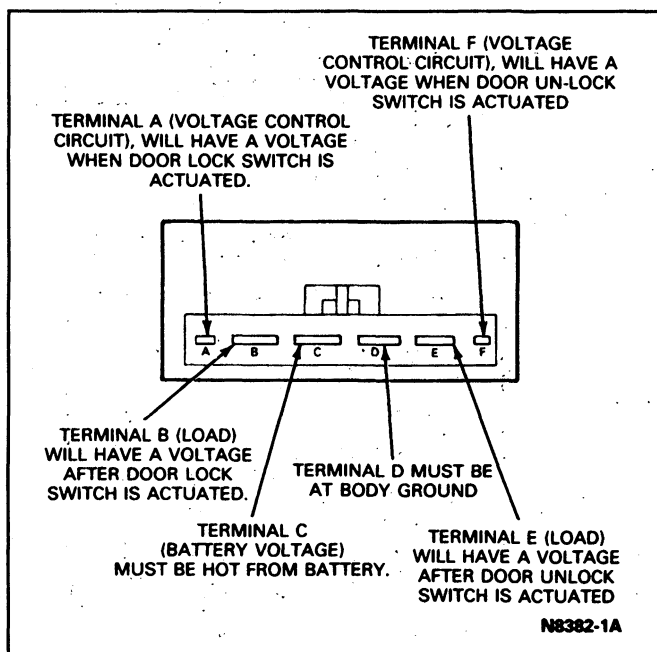


FIG. 3 Door Lock Relay Assembly Terminals—E-150—E-350

### Switch

#### E-150—E-350

Using a self-powered test lamp, there should be **no continuity** between any terminals with the switch in its normal position.

Continuity should exist between terminals A and B with the switch held in the down (LOCK) position and

between terminals A and C with the switch held in the up (UNLOCK) position (Figs. 2 and 5).

#### F-150—F-350 and Bronco

Procedures for testing the power door lock switch is the same as for the single power window switch. Refer to Section 42-08, Power Windows.

There is no relay test. Power is supplied directly to the door lock motor through the switch located in the door trim panel.

### REMOVAL AND INSTALLATION

**NOTE:** Due to the conversion from single 90 degree Rod end shape to double 90 degree Rod end shape, it may be necessary to remove more parts than the instructions indicate. This action will allow more maneuverability of the Rod and ease the Removal Process.

#### Electric Door Lock Actuator Motor

##### E-150—E-350, F-150—F-350 and Bronco

#### Removal

1. Remove door trim panel. Refer to Section 45-03, Door Trim Panels.
2. Disconnect the actuator motor (Figs. 6 and 7) link from the door latch.
3. Remove actuator motor and swivel bracket assembly from the door by drilling out the retaining pop rivet.
4. Disconnect the wire harness plug at the motor connector (Figs. 6 and 8).

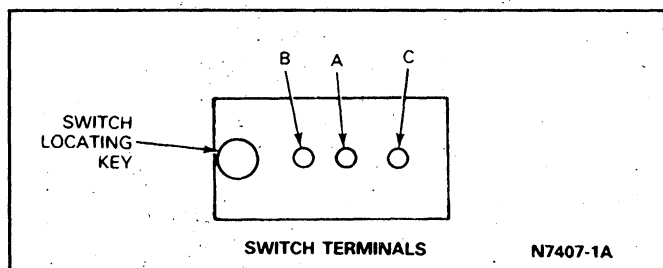


FIG. 4 Door Lock Switch

**Installation**

1. Connect wire harness plug at actuator motor connector (Figs. 6 and 8).
2. Install door lock actuator motor in door with pop rivet (Figs. 6 and 7).

NOTE: Pop rivet must retain the actuator bracket securely. A loose bracket will affect actuator function by causing a loss of travel, or by causing binding or rattle.

3. Connect actuator motor link to the door latch.
4. Check operation for correct function.
5. Install door trim panel.

NOTE: Old motor bracket must be replaced with new bracket which is supplied with replacement actuator motor assembly.

**Door Lock Control Switch**

Refer to Fig. 6.

**E-150—E-350****Removal and Installation**

The power door lock switches are located on the front door trim panels. To replace a switch, remove the bezel retaining screw. Then, lift the bottom of the bezel from the door trim panel and remove the switch and bezel assembly.

Remove the wiring connector retaining screw from the back of the bezel. Using a thin-bladed screwdriver, carefully pry the switch from the connector.

To install the switch, reverse the removal procedure.

**F-150—F-350 and Bronco**

The power door lock switches are located on the front door trim panels.

**Removal**

1. Insert a small, thin-bladed screwdriver into the spring tab slots (located at the front and rear of the switch housing) and apply pressure to make the switch housing assembly pop out.
2. Remove the three connector attaching screws from the switch housing.
3. The switch is held in place by the electrical contact pins. To remove the switch, carefully pry the switch from the connector with a small screwdriver.

**Installation**

1. Position the switch to the connector and press firmly into place.

NOTE: The switch is keyed to the connector and can only be installed one way.

2. Install the connector to the switch housing using the three attaching screws.
3. Position the switch housing to the door trim panel and press firmly into place.

**Door Lock Relay**

Refer to Fig. 9.

**E-150—E-350****Removal and Installation**

To remove the door lock relay from the LH dash panel brace, insert a small screwdriver to pop free. Disconnect the relay from the wiring assembly by separating the locking fingers and remove the relay.

**CAUTION: Carefully spread retaining legs to prevent breakage.**

To assemble the wiring connector to the relay, press firmly on the locking fingers until they latch behind the locking clamps on the connector. Snap the relay assembly locator pin into hole on brace.



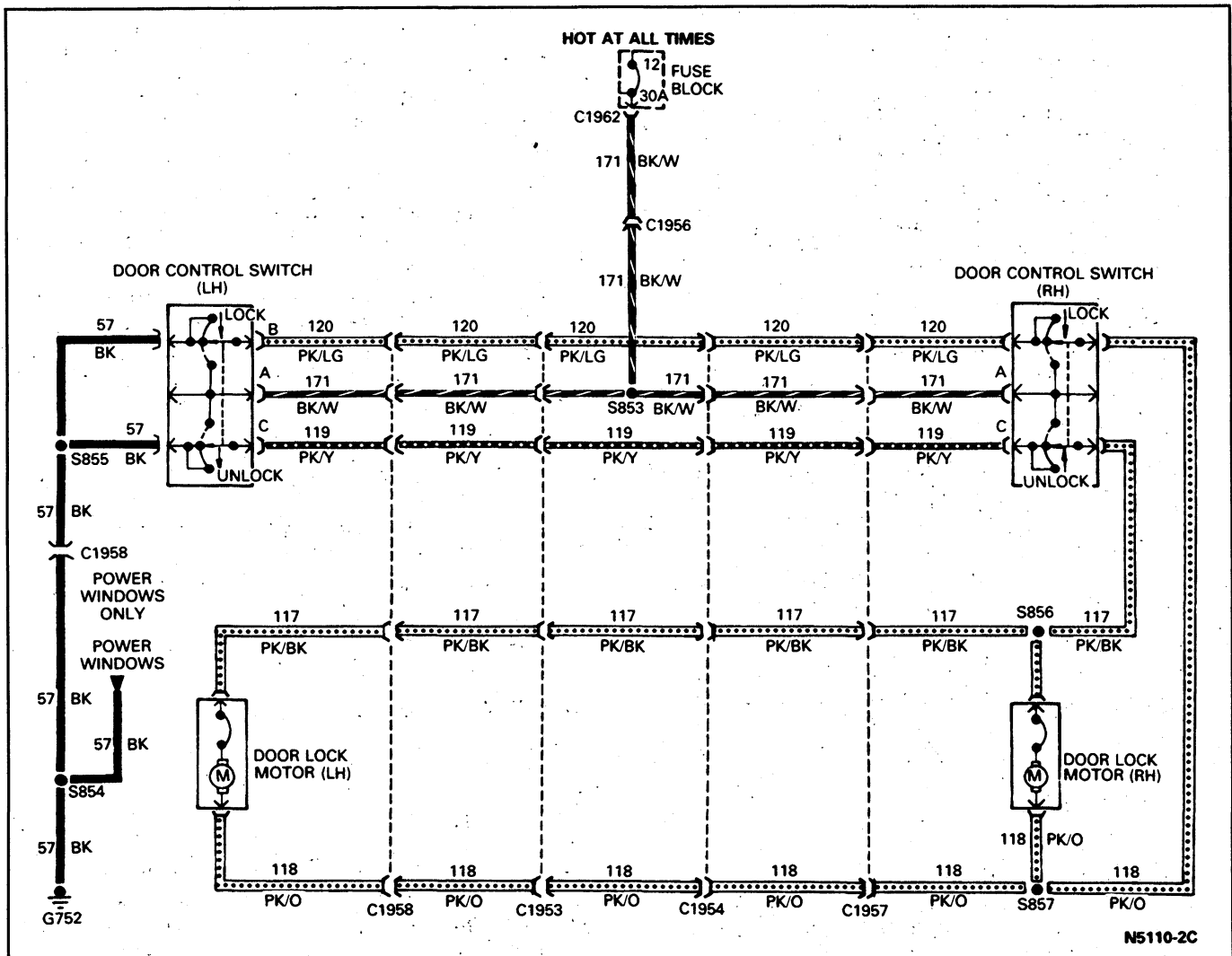


FIG. 5 Power Door Lock Electrical Schematic—F-150—F-350 and Bronco

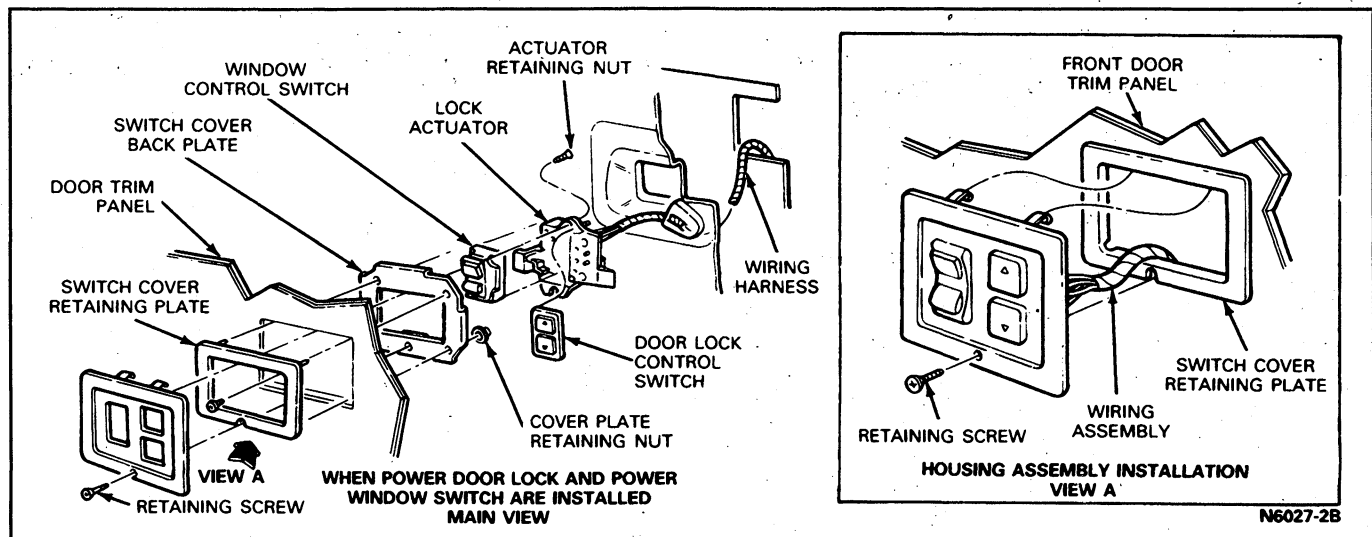


FIG. 6 Door Lock Control Switch—E150—E-350

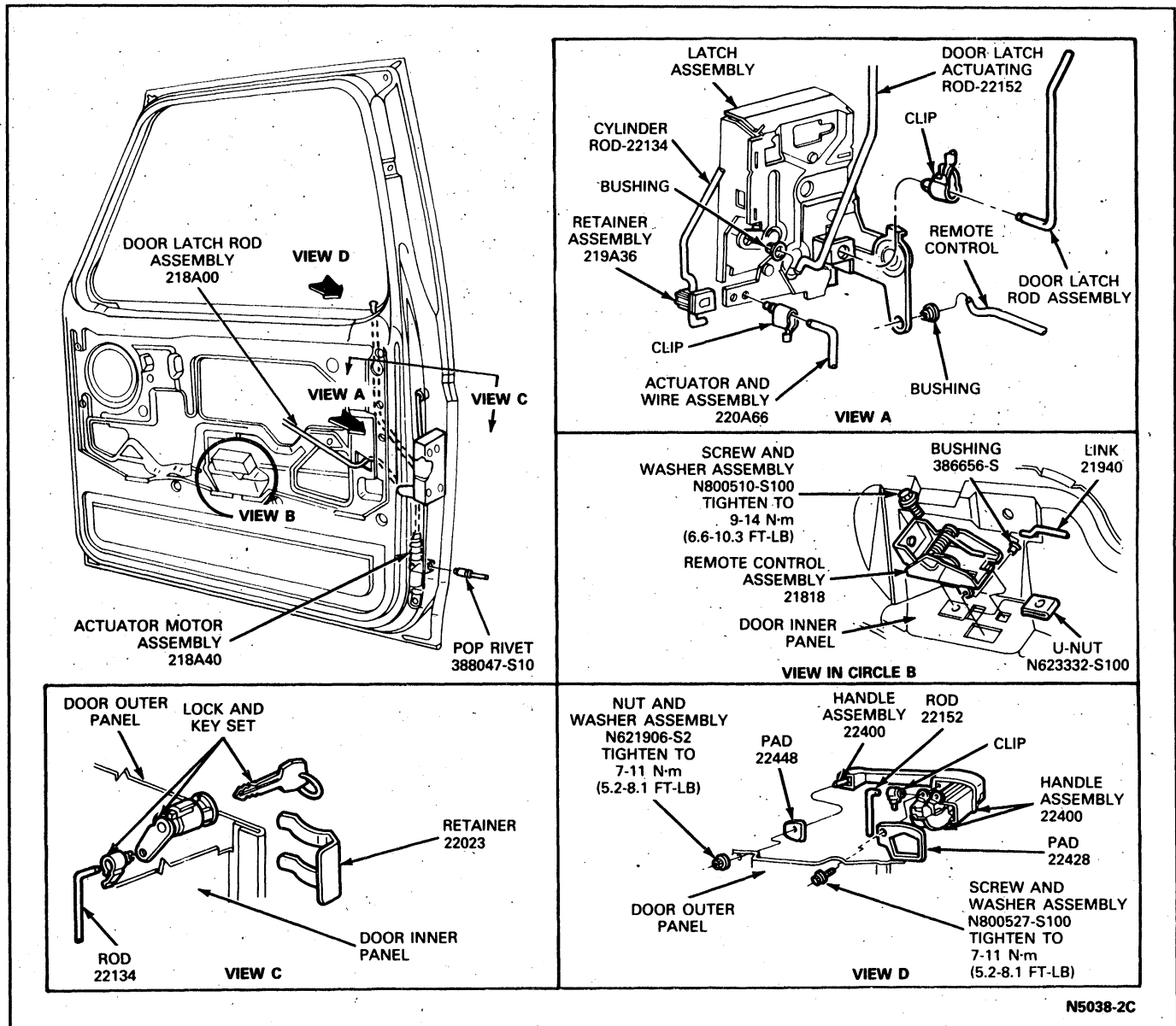


FIG. 7 Electric Door Lock Installation—F-150—F-350 and Bronco

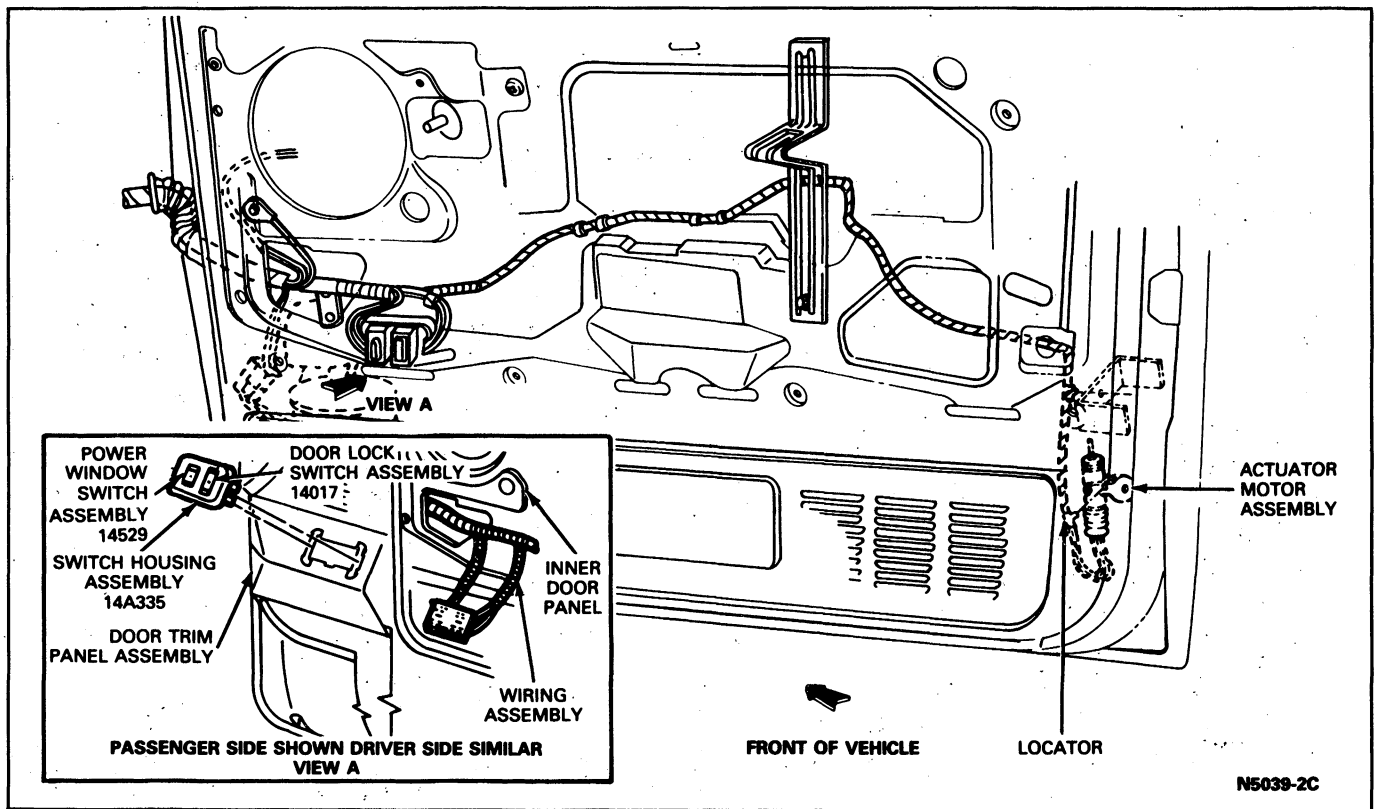


FIG. 8 Electric Door Lock Actuator Motor and Control Switch Wiring—F-150—F-350 and Bronco

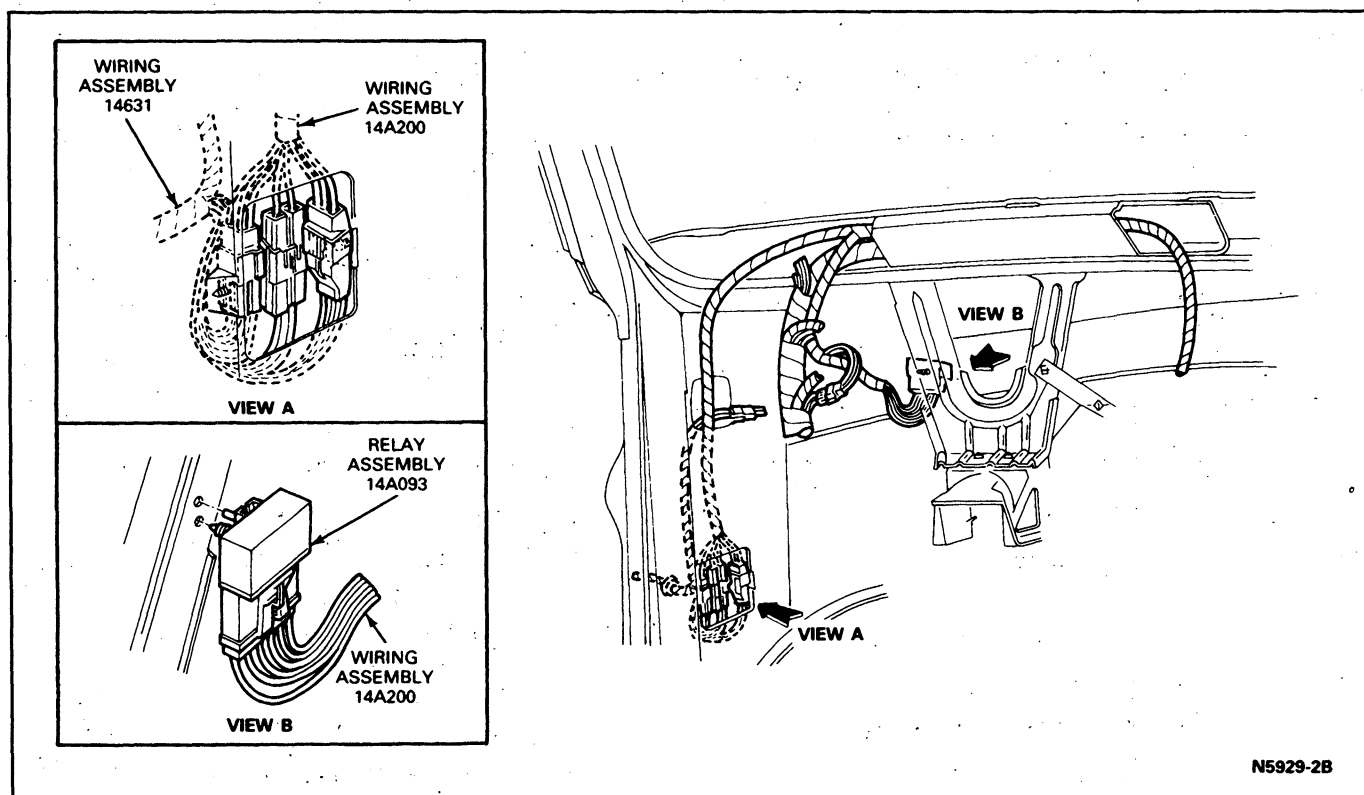


FIG. 9 Door Lock Relay Assembly Removal—E-150—E-350

**SPECIAL SERVICE TOOLS****ROTUNDA EQUIPMENT**

Model	Description
007-00001	Digital Volt-Ohm Meter

CN6078-1B

# SECTION 44-21 Hood and Hinges

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
E-150—E-350 and Club Wagon .....	44-21-1	Hood Hinge .....	44-21-2
F-150—F-350 and Bronco .....	44-21-1	E-150—E-350 .....	44-21-2
<b>REMOVAL AND INSTALLATION</b>		F-150—F-350 and Bronco .....	44-21-2
Hood .....	44-21-1	<b>VEHICLE APPLICATION</b> .....	44-21-1
E-150—E-350 .....	44-21-2		
F-150—F-350 and Bronco .....	44-21-1		

## VEHICLE APPLICATION

E-150—E-350 and F-150—F-350.

## ADJUSTMENTS

### F-150—F-350 and Bronco

1. Open the hood and mark the hinge and latch assembly locations.
2. Loosen the hinge-to-fender inner attaching screws until they are snug (Fig. 1).

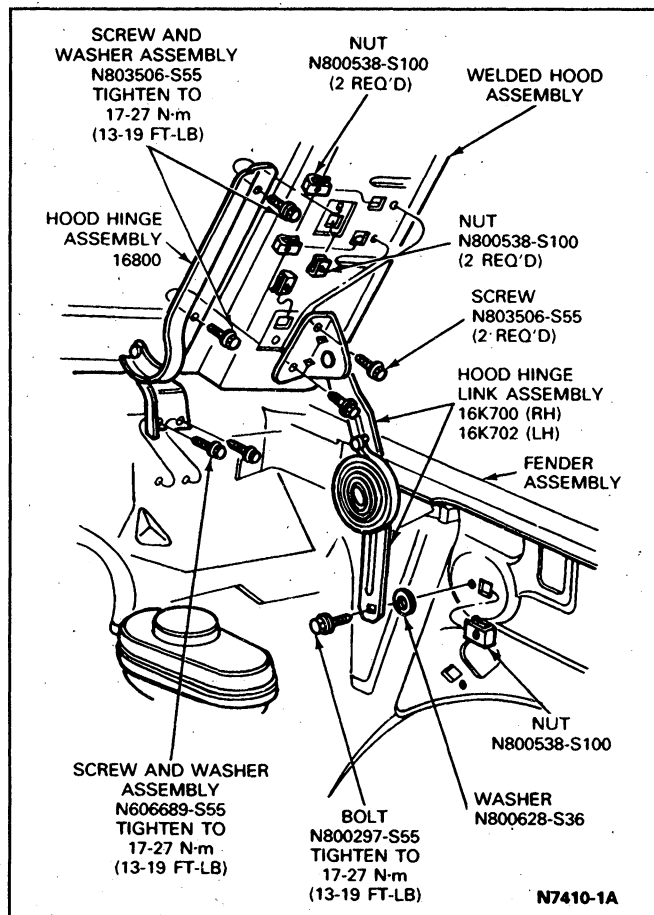


FIG. 1 Hood, Hinge Installation—Bronco and F-150 and F-350

3. Adjust the hinge up or down or rotate as required to obtain a flush fit between the hood and the top of the cowl panel. Then, tighten the hinge-to-fender inner attaching screws.
4. Loosen the two hood latch assembly attaching screws (Fig. 1, View A).
5. Loosen the hinge-to-hood attaching bolts until they are snug. Move the hood forward or rearward and from side to side as required for a proper hood fit. Then, tighten the hinge-to-hood attaching screws. Move the latch from side to side as required to center the latch with the hood striker. Tighten the hood latch attaching screws.
6. Lubricate each hood hinge at all pivot points with Multi-Purpose Grease Spray D7AZ-19584-AA or equivalent. Check the functional operation of the hinges by opening and closing the hood several times to ensure alignment is correct and the lubricant has effectively worked into the pivot points.

### E-150—E-350 and Club Wagon

The hood can be adjusted fore and aft and up and down to obtain the proper clearance. To adjust the hood, loosen the hood-to-hinge attachments (fore-or-aft adjustment) or the hinge-to-cowl attachments (up-or-down adjustment) until they are snug. Then, position the hood as required, and tighten the attachments (Fig. 2). After the hood has been adjusted, check the hood latch adjustment. Adjust the hood latch if required. Refer to Section 44-31, Hood Latch.

## REMOVAL AND INSTALLATION

### Hood

#### Removal and Installation

#### F-150—F-350 and Bronco

1. Remove the two link assembly bolts.
2. Remove the hood hinge bolts. With an assistant, lift the hood off the hinges.
3. If the hood is to be replaced, transfer the hood latch components and ornaments to the new hood.
4. With the aid of an assistant, position the hood on the hinges and install the hinge bolts snug.
5. Install link assembly to hood with two bolts.
6. Adjust the hood for a proper fit by shifting the hood on the hinges. Tighten the hinge bolts (Fig. 1).

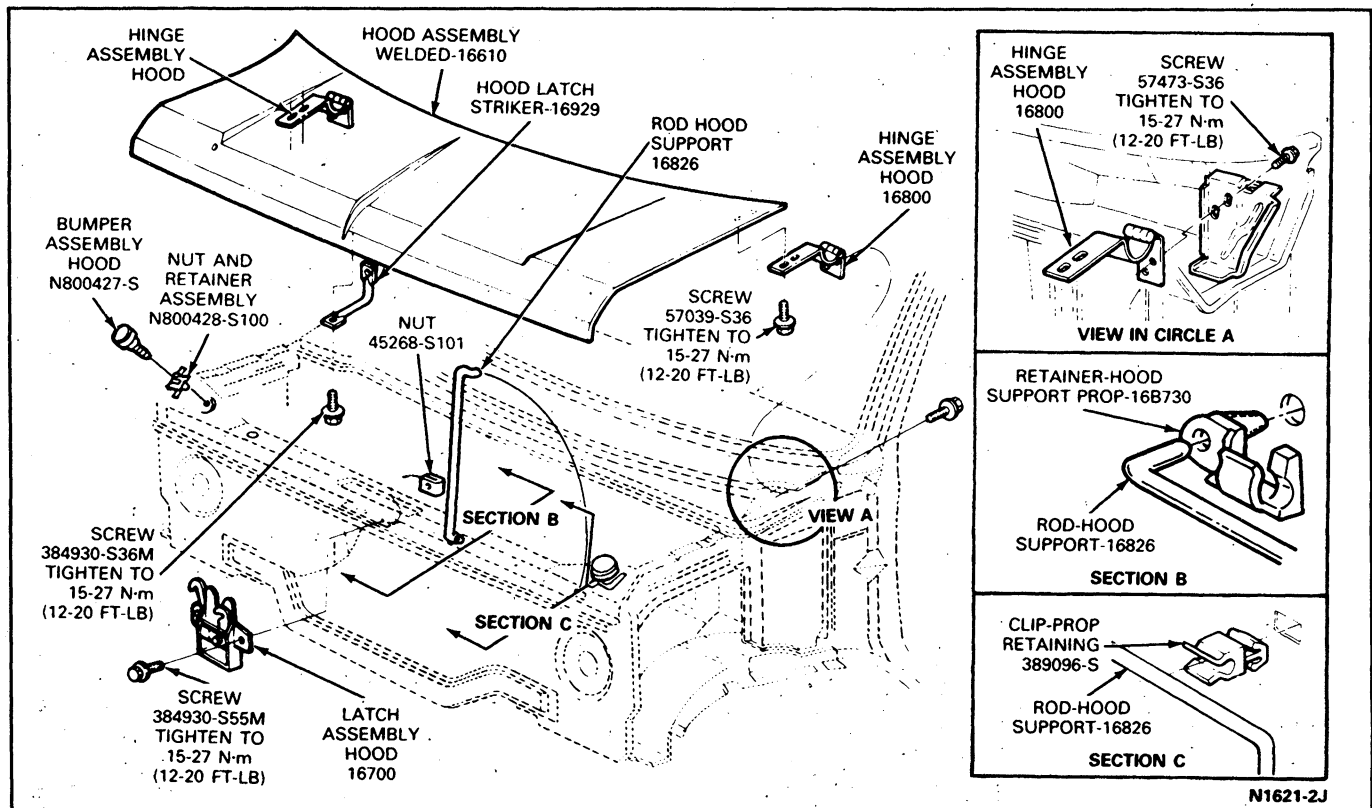


FIG. 2 E-150—E-350 Hood Installation—Steel

- Adjust the hood latch for proper alignment. Refer to Section 44-31, Hood Latch.

**E-150—E-350****Removal**

- Open the hood. Retain in the open position (Fig. 2).
- Cover the cowl area to prevent paint damage.
- Remove screws or nuts attaching each hood hinge to the hood and remove the hood from the vehicle.
- Remove the hood lock striker from the hood.

**Installation**

- Position the hood to the hood hinges and install the attaching screws or nuts.
- Adjust the hood as outlined. Tighten the hood-to-hinge attaching screws or nuts.
- Install the hood lock striker on the hood and adjust the hood latch if required.

NOTE: The fiberglass hood outside surface can be repaired if the damage is minor (scratches, dents). Normal fiberglass repair procedures should be followed. Refer to Section 46-51, Fiberglass Rear Roof. Under no circumstances should any repairs be made to the inside surface of the hood.

**Hood Hinge****F-150—F-350 and Bronco**

Refer to Fig. 1.

**Removal**

- Open the hood. Retain in the open position with a suitable prop.
- Mark the locations of the hinges.

- Remove four screws attaching each hinge assembly to the hood and remove the hood from the vehicle. Do not allow the hood to slide down as damage to the cowl top may result.
- Remove the hinge attaching bolts and remove the hinge from the vehicle.

**Installation**

- Position the new hinges to the vehicle and install the attaching bolts snug.
- Position the hood to the hinges and install the four attaching screws snug.
- Remove the prop supporting the hood in the open position.
- Close the hood and adjust as outlined.

**E-150—E-350****Removal**

- Open the hood. Retain in the open position.
- Cover the cowl area to prevent paint damage.
- Remove hinge-to-body attachments (Fig. 2) and remove hood.
- Remove hinge-to-hood attachments and remove the hinge.

**Installation**

- Position the hinge to the hood and install the attaching screws snug.
- Position the hinge to the body and install the attaching screws snug.
- Adjust the hood as outlined. Tighten the hinge attaching screws.
- Remove the protective cover and close the hood.

# SECTION 44-31 Hood Latch

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>REMOVAL AND INSTALLATION</b>	
Hood Latch Adjustment .....	44-31-1	Hood Latch .....	44-31-2
F-150—F-350, E-150 Through E-350, and Bronco .....	44-31-1	F-150—F-350, E-150 Through E-350, and Bronco .....	44-31-2
Hood Latch—Remote Control Cable .....	44-31-2	<b>VEHICLE APPLICATION</b> .....	44-31-1
E-150 Through E-350, F-150—F-350, and Bronco .....	44-31-2		

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350 and Bronco.

## ADJUSTMENTS

### Hood Latch Adjustment

#### F-150—F-350, E-150 Through E-350, and Bronco

Before adjusting the hood latch, ensure the hood is properly aligned. Refer to Section 44-21, Hood and Hinges. The hood latch can be moved from side to side and up and down to obtain a snug hood fit (Figs. 1 and 2).

1. Loosen the hood latch attaching screws just enough to move the latch.

2. Move the latch until it is aligned with the hood latch striker. Then, tighten the latch attaching screws.
3. Check the hood latch to ensure it makes full engagement with the hood latch striker. If the hood latch does not make full engagement with the hood latch striker, loosen the hood latch attaching screws and reposition the latch to obtain full engagement. Then, tighten the attaching screws.
4. Lubricate the latch handle pivot, catch pawls and spring with Multi-Purpose Grease Spray D7AZ-19584-AA or equivalent. Check the functional operation of the latch mechanism by opening and closing the hood several times to ensure alignment is correct. Ensure lubricant has effectively worked into the pivot points and bearing surfaces.

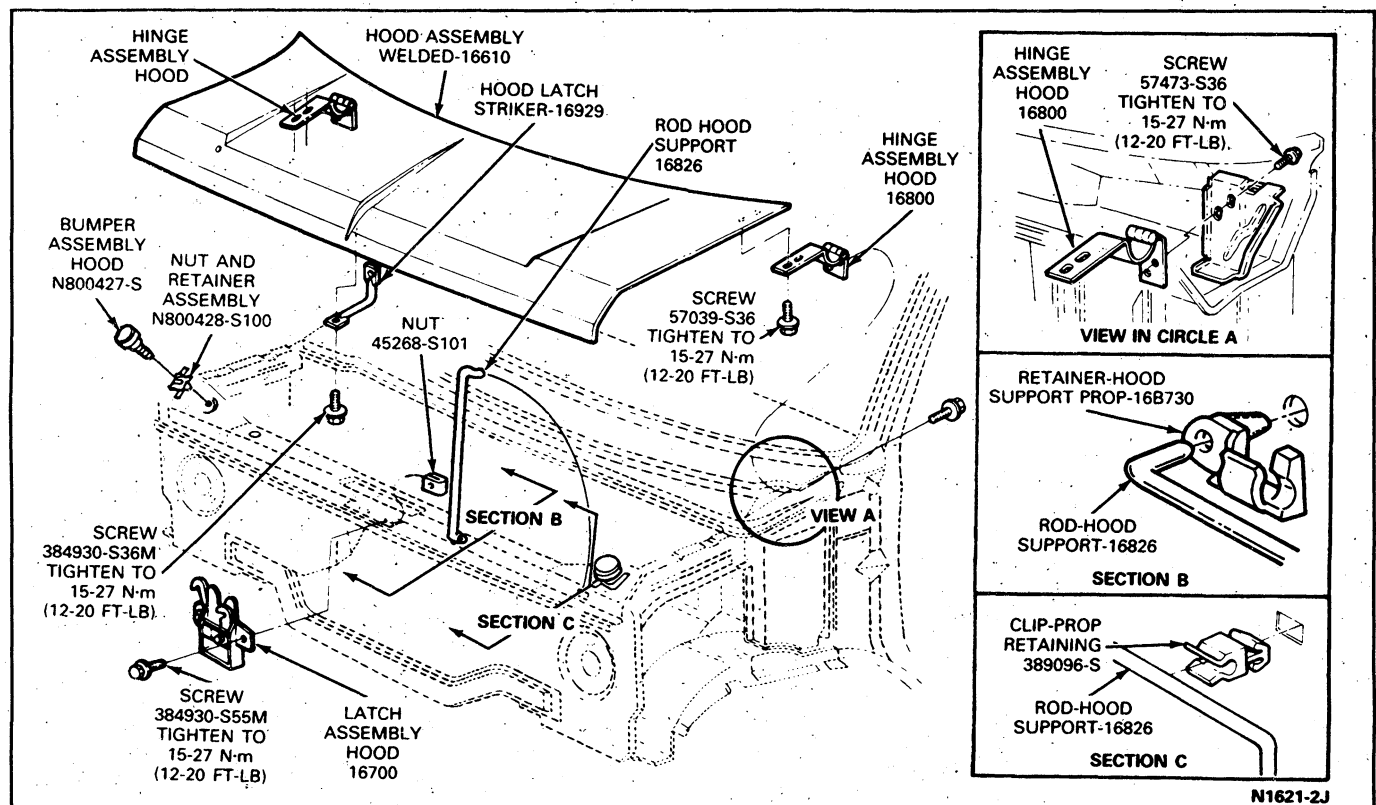


FIG. 1 Hood Latch Adjustment—E-150—E-350

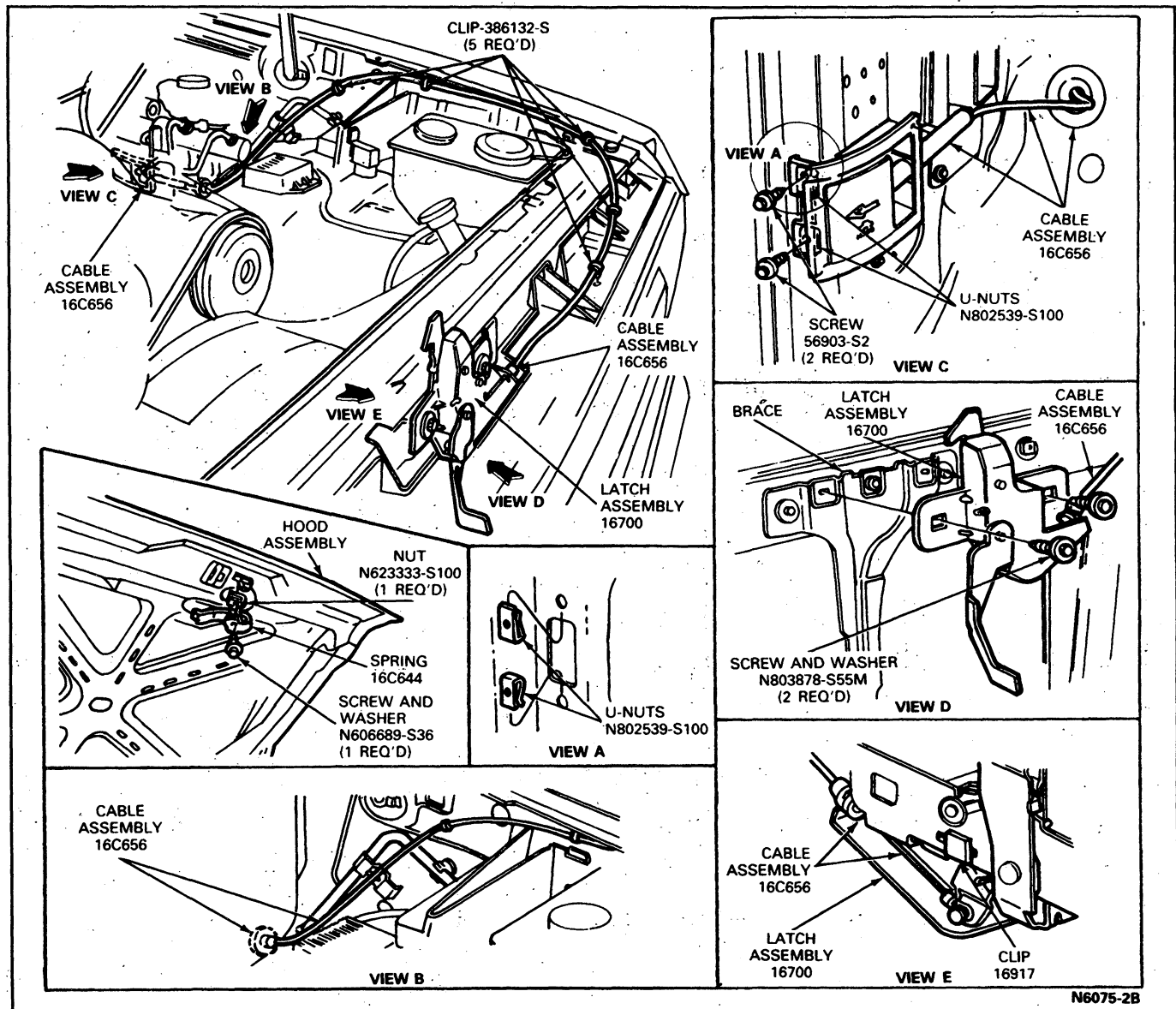


FIG. 2 Hood Latch Remote Control Cable and Lock—F-150—F-350 and Bronco

### Hood Latch—Remote Control Cable

#### E-150 Through E-350, F-150—F-350, and Bronco

The remote control-operated hood latch is adjusted the same as the non-remote latch.

The release cable and handle is routed as shown in Figs. 2 and 3.

### REMOVAL AND INSTALLATION

#### Hood Latch

##### Removal and Installation

#### F-150—F-350, E-150 Through E-350, and Bronco

Mark location of hood latch prior to removal to aid in positioning of new latch when installed.

1. If so equipped, remove the hood latch cable plate screw, the cable plate, cable clip and cable from the hood latch (Figs. 2 and 3).
2. Remove the hood latch attaching screws and remove the latch assembly (Figs. 1, 2 and 3).
3. Position the latch assembly and install the attaching screws snug, but do not tighten.
4. Install the hood release cable, cable clip, hood latch cable plate and cable plate screw.
5. Adjust the latch assembly for positive engagement with the hood latch striker. Tighten the latch attaching screws.
6. Lubricate the latch handle pivot, catch pawls and spring with Multi-Purpose Grease Spray D7AZ-19584-AA or equivalent. Check the functional operation of the latch mechanism by opening and closing the hood several times to ensure alignment is correct. Ensure lubricant has effectively worked into the pivot points and bearing surfaces.



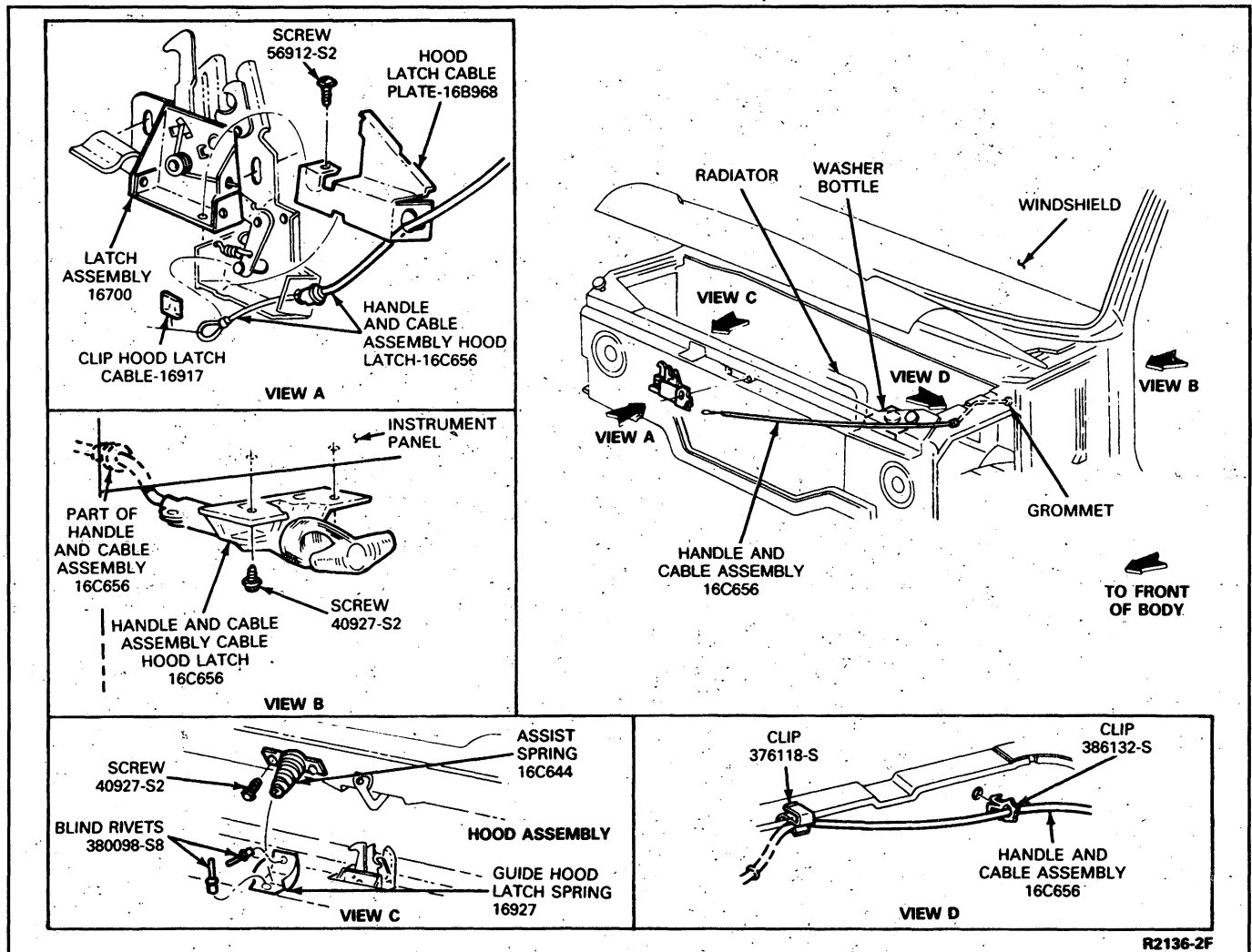


FIG. 3 Hood Latch Remote Control Cable and Lock—E-150 Through E-350

# SECTION 44-86 Tailgate

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Handle and Control Assembly .....	44-86-1	Tailgate Latch Release Handle and Lock	
Tailgate .....	44-86-1	Release Control Assemblies .....	44-86-1
Bronco .....	44-86-1	Bronco .....	44-86-1
F-150—F-350 Pickup .....	44-86-1	Tailgate Weatherstrip .....	44-86-2
Tailgate Latch and Support Cable .....	44-86-1	Bronco .....	44-86-2
F-150—F-350 Pickup .....	44-86-1	<b>VEHICLE APPLICATION</b> .....	44-86-1

## VEHICLE APPLICATION

F-150—F-350 And Bronco.

## REMOVAL AND INSTALLATION

NOTE: Due to the conversion from single 90 degree Rod to double 90 degree Rod, it may be necessary to remove more parts than the instructions indicate. This action will allow more maneuverability of the Rod and ease the Removal Process.

### Tailgate Latch and Support Cable

#### F-150—F-350 Pickup

##### Removal and Installation

1. Remove 10 retaining screws from tailgate inside panel access opening cover to tailgate assembly and remove.
2. Disconnect two tailgate latch release links from tailgate latch control assembly.
3. Remove two screws retaining tailgate latch assembly to the panel assembly. Remove latch assembly (both sides) by sliding out the link.
4. Remove link from latch assembly.
5. Remove support cable from latch assembly by removing screw retaining support cable to latch and remove cable.
6. Prior to installation take out the slack in the links and latches by gently pulling the link to the center of the tailgate. Close plastic clip over the closest thread of the link.
7. To install, reverse Steps 1 through 5.

### Handle and Control Assembly

#### Removal and Installation

1. Remove tailgate inside panel access opening cover.
2. Disconnect two tailgate latch release links from tailgate latch control assembly.
3. Remove two nut and washer assemblies retaining handle and control assembly to tailgate outside panel assembly and remove handle and control assembly.
4. Prior to installation take out the slack in the links and latches by gently pulling the link to the center of the tailgate. Close plastic clip over the closest thread of the link.

5. To install, reverse Steps 1 through 3.

## Tailgate

### F-150—F-350 Pickup

#### Removal and Installation

Remove the tailgate support strap at the pillar T-head pivot. Lift off the tailgate at RH hinge; then pull off the LH hinge. If a new tailgate is being installed, transfer all mouldings, latches, hinges, brackets, links, clips and washers to the new tailgate.

#### Bronco

##### Removal

1. Unlatch the tailgate handle (Fig. 2) and lower the tailgate. Disconnect the LH and RH cable assemblies at the tailgate (Fig. 3; View B).
2. Disconnect the tailgate window motor wire at the connector. Pull the lead wire from the tailgate body rail.
3. Support the tailgate while it is in the up position and slightly open, and remove the torsion bar retainer from the body (Fig. 3, View B).
4. Remove the three screw and washer assemblies that secure the LH and RH hinge assemblies (Fig. 3, View B) to the body.
5. Remove the tailgate from the vehicle.

##### Installation

1. Position the tailgate to the body and support.
2. Secure the hinge assemblies to the tailgate.
3. Attach the torsion bar retainer over the torsion bar.
4. Connect the tailgate window motor wire.
5. Secure the cable assemblies at the tailgate. Remove support and check tailgate operation.

### Tailgate Latch Release Handle and Lock Release Control Assemblies

#### Bronco

##### Removal

1. Lower the tailgate and remove the inner access cover (Fig. 2).
2. Remove two screws attaching the handle assembly to the tailgate (Fig. 2).

3. Remove the rod from the clip retaining the handle rod to the lock control.
4. Remove the handle and rod assembly.
5. Disconnect the latch release links and the latch control rod (Fig. 2, View A).
6. Disconnect the electrical connector from the interlock switch (Fig. 2, View A).
7. Remove three screw and washer assemblies that retain the lock control to the tailgate.
8. Remove the lock control from the tailgate.

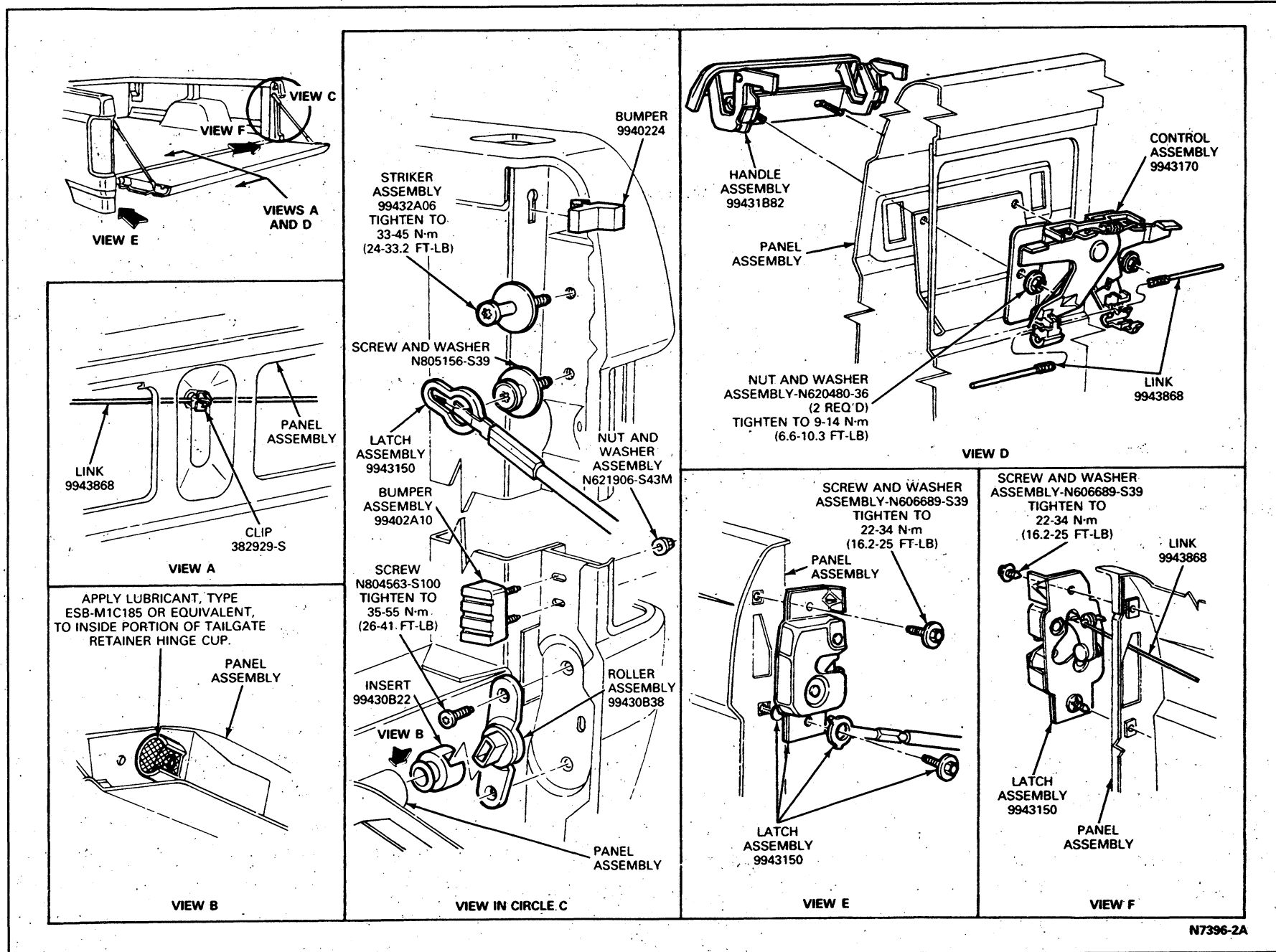
**Installation**

1. Position the lock control into the tailgate. Install three screw and washer assemblies and tighten to 9-14 N·m (6-11 ft-lb).
2. Connect the electrical connector.

3. Position the latch control rod and install the clip.
4. Position the latch release links and install the clips.
5. Position handle and rod assembly to the tailgate. Connect the rod to the lock control and install clip.
6. Secure two screws retaining the handle assembly to the tailgate.
7. Install the inner access cover.

**Tailgate Weatherstrip****Bronco****Removal and Installation**

Refer to Section 44-92, Tailgate Weatherstrip for tailgate weatherstrip removal and installation procedures.



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Fig. 1 Tailgate Installation—Styleside Pick-Up

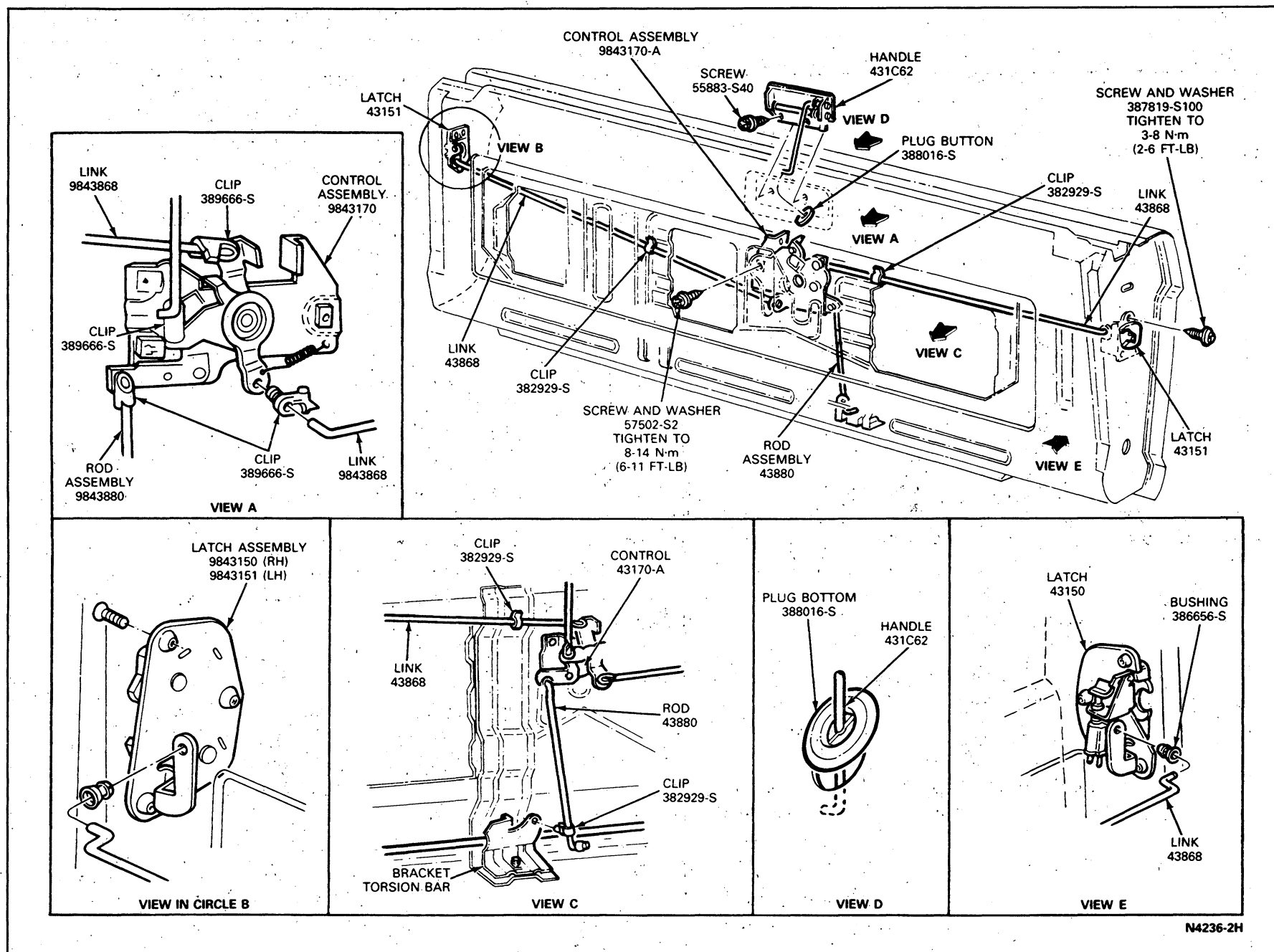


FIG. 2 Tailgate Latch Release and Lock Control—Bronco

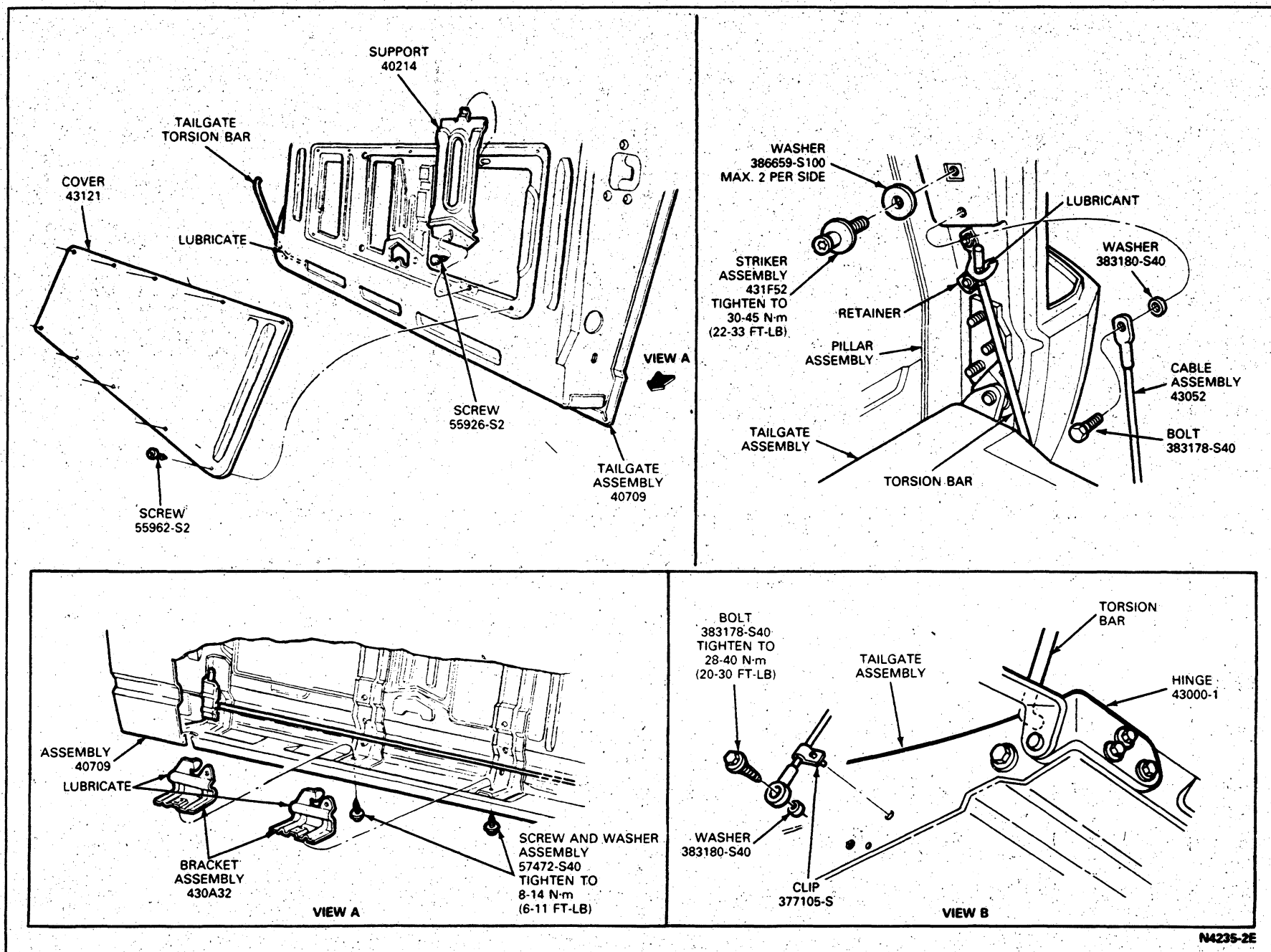


FIG. 3 Tailgate Installation—Bronco

## SECTION 44-92 Tailgate Weatherstrip

**SUBJECT****PAGE****SUBJECT****PAGE****REMOVAL AND INSTALLATION**

Tailgate Weatherstrip Assembly ..... 44-92-1

VEHICLE APPLICATION ..... 44-92-1

**VEHICLE APPLICATION**

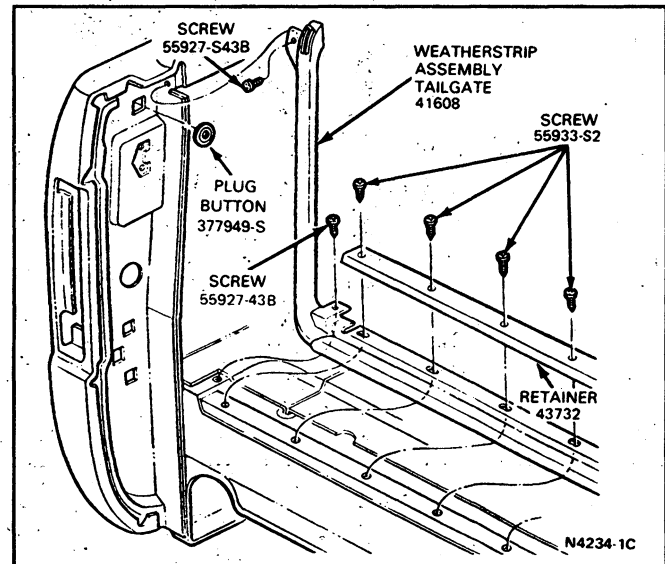
All Models.

**REMOVAL AND INSTALLATION****Tailgate Weatherstrip Assembly****Removal**

1. Lower the tailgate.
2. Remove the screws attaching the tailgate weatherstrip and weatherstrip retainer to the body (Fig. 1).
3. Remove weatherstrip and retainer from the body.

**Installation**

1. Position the weatherstrip to the body and install the upper attaching screws.
2. Secure the right and left weatherstrip attaching screws to the body sill and push the weatherstrip onto the body pillar flange.
3. Position the lower weatherstrip retainer to the body and attach with eleven screws.

**FIG. 1 Tailgate Opening Weatherstrips—Bronco**

# GROUP INTERIOR TRIM 45

(70000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
CARPETS AND FLOOR MATS .....	45-26-1	INSTRUMENT PANEL AND PAD .....	45-61-1
CONSOLE ASSEMBLY .....	45-31-1	INTERIOR TRIM—GENERAL SERVICE .....	45-01-1
DOOR TRIM PANELS .....	45-03-1	INTERIOR TRIM PANELS .....	45-11-1
HEADLINING .....	45-41-1	MOULDINGS .....	45-16-1

## SECTION 45-01 Interior Trim—General Service

SUBJECT	PAGE	SUBJECT	PAGE
<b>CLEANING PROCEDURE</b>		<b>CLEANING PROCEDURE (Cont'd)</b>	
Cleaning Lap-Shoulder Safety Belt		Cleaning Simulated Woodgrain or Plastic	
Webbing .....	45-01-2	Interior .....	45-01-2
Cleaning Leather or Vinyl Interior		Fabrics .....	45-01-1
Trim .....	45-01-2	VEHICLE APPLICATION .....	45-01-1

### VEHICLE APPLICATION

All Models.

### CLEANING PROCEDURE

#### Fabrics

The following procedure is recommended for the removal of spots and stains encountered in service. It is important that proper cleaning techniques and cleaning agents be used to prevent the stain from setting, or alteration of the color and/or flame-resistant properties of the fabric.

1. Remove excess staining material from fabric by scraping or wiping with a clean cloth (blot if stain is wet).
2. Identify the staining material if possible.
3. Clean the fabric as outlined in the following Methods "A", "B", or "C".

**CAUTION: Test all cleaners in a small hidden area of the fabric prior to use. If fabric color or texture is adversely affected by a particular cleaner, do not use.**

**METHOD "A" (SPOT CLEANING)** Stains such as grease, oil, tar, water spots, crayon and lipstick.

**NOTE:** Using other than recommended cleaners or procedures may adversely affect fabric flammability, appearance or durability.

1. Spray stain with Ford Spot Lifter E2AZ-19526-A or equivalent from a distance of 203-254mm or (8-10 inches) as directed on the instructions furnished with the can.
2. Allow the Spot Lifter to dry completely, forming a white powder on the surface of the fabric.
3. Brush and vacuum the white powder from the surface of the fabric.
4. If the soiled spot is not removed from the fabric, repeat Steps 1, 2 and 3 as necessary.

**CAUTION: Use care during application of the spot lifter to avoid contact with vinyl trim.**

**METHOD "B" (GENERAL CLEANING)** Stains such as grease, oil, tar, adhesive, crayon and lipstick.

1. If the stain is still visible after performing spot cleaning procedure (Method "A"), blot the soiled area with a clean cotton cloth saturated with Extra Strength Spot and Stain Remover B7A-19521-AA or equivalent.



2. Rub in a circular motion while continuously exposing clean portion of cloth.
3. Gradually widen area of application onto edges of design, pleat, or biscuit.
4. Repeat Steps 1, 2 and 3 as necessary.
5. Wipe cleaned area with clean, damp cloth to remove any residual cleaner.

**METHOD "C" (GENERAL CLEANING)** Stains such as dirt, dry soil, food, pop and coffee.

1. Apply "Rosenthal" multi-purpose rug and upholstery cleaner with a clean brush or sponge as directed in the label instructions.
2. Rub in a circular motion until stain is removed.
3. Gradually widen area of application to edges of design, pleat, or biscuit.
4. Repeat Steps 1, 2 and 3 as necessary.
5. Rub cleaned area with a damp cloth to absorb residual cleaner.
6. Allow to dry at room temperature.

**NOTE:** Spot cleaning described in Method "A" will be sufficient on fabrics which are not excessively soiled. However, to maintain a uniform appearance of the seat

material in the event of severe soil and stain, the entire seat or insert will have to be cleaned to prevent a "ring" condition.

### **Cleaning Simulated Woodgrain or Plastic Interior Trim**

Clean soiled or stained surfaces with Multi-Purpose Cleaner Concentrate B8A-19523-AA or equivalent, diluted in accordance with label instructions. Apply cleaner with a soft cloth. Remove mild abrasions (key marks, etc.) on woodgrains surfaces with Ford Custom Silicone Gloss B7A-19530-A, Ford Custom Auto Wax B4A-19534-A, or equivalent.

### **Cleaning Leather or Vinyl Interior Trim**

Clean vinyl or leather interior trim with Deluxe Leather and Vinyl Cleaner E0AZ-19521-AA or equivalent by following instructions on the label.

### **Cleaning Lap-Shoulder Safety Belt Webbing**

Clean the belt webbing with any mild soap solution recommended for cleaning upholstery or carpets; follow the instructions provided with the soap.

**CAUTION: Do not bleach or re-dye the webbing. Bleaching or dyeing the webbing can reduce both belt effectiveness and occupant safety.**

# SECTION 45-03 Door Trim Panels

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Door-Trim Panel .....	45-03-1	Side and Rear Door Trim Panel (Cont'd)	
Bronco, F-150—F-350 and F-Super .....	45-03-1	E-150—E-350 Super Vans Rear Door .....	45-03-3
E-150—E-350 .....	45-03-1	Sliding Door Trim Panel .....	45-03-2
Side and Rear Door Trim Panel .....	45-03-2	E-150—E-350 and Club Wagon .....	45-03-2
E-150—E-350—Cargo Van Hinged .....	45-03-3	E-150—E-350 Cargo Van .....	45-03-2
E-150—E-350 Cargo Vans and Wagons .....	45-03-3	<b>SPECIAL SERVICE TOOLS</b> .....	45-03-8
E-150—E-350 Side Hinged Door Trim Panels .....	45-03-3	<b>VEHICLE APPLICATION</b> .....	45-03-1

## VEHICLE APPLICATION

E-150-E-350, F-150-F-350, F-Super Duty and Bronco.

## REMOVAL AND INSTALLATION

### Door-Trim Panel

#### Bronco, F-150—F-350 and F-Super Duty

#### Removal

1. Remove the screw(s) retaining the armrest area of the trim panel to the door inner panel (Figs. 1 and 2).
2. Remove the screw retaining the door inside handle and remove the handle (Fig. 3). Refer to Section 44-06, Doors, Hinges, Checks and Weatherstrips.
3. Remove the screw retaining the door window regulator handle and remove the handle and washer, if so equipped (Fig. 3).

NOTE: On units with power windows, remove the power window switch housing (Fig. 4). Refer to Section 42-08, Power Windows.

4. Remove the door lock control, if so equipped (Fig. 5).

NOTE: On units with power door locks, remove the power door lock switch housing. Refer to Section 44-16, Power Door Locks.

5. Remove the switch housing for the power rear view outside mirror, if so equipped. Refer to Section 35-50, Mirrors—Inside and Outside.
6. Using the Trim Pad Removing Tool from Rotunda Moulding/Trim Kit 107-00401 or equivalent, carefully pry the trim panel away from the door inner panel and remove the trim panel.

NOTE: At no time should the trim panel be used to remove push pins from the inner panel holes.

#### Installation

1. Replace any bent, damaged or missing push pins on the door trim panel. Position the trim panel to the door inner panel, locating push pins in the countersunk holes. Firmly push the trim panel at the push pin locations to seat each push pin into the holes in the door inner panel.

2. Install the switch housing for the power rearview outside mirror, if so equipped.

3. Install the door lock control, if so equipped.

NOTE: On units with power door locks, install power door lock switch housing.

4. Position door window regulator handle to door and install retaining screw.

NOTE: On units with power windows, install power window switch housing.

5. Install inside door handle and retaining screw.
6. Position trim panel armrest area to door panel and install retaining screws(s).

#### E-150—E-350

#### Removal

1. Remove the armrest-retaining screws and remove the armrest from the door inner panel (Fig. 5).
2. Remove the two nuts from the inside door handle and remove the handle and trim cup. Refer to Group 44.
3. If the vehicle is equipped with a stereo radio, remove four screws retaining the speaker grille and remove the grille.
4. Remove the window regulator handle retaining screw. Remove the handle and washer.
5. Using the Trim Pad Removing Tool from Rotunda Moulding/Trim Kit 107-00401 or equivalent, carefully pry trim panel away from door inner panel and remove trim panel.

NOTE: At no time should the trim panel be used to remove the push pins from the inner panel holes.

#### Installation

1. Replace any bent, damaged or missing push pins on the door trim panel. Position the trim panel to the door inner panel, locating the push pins in the countersunk holes. Firmly push the trim panel at the push pin locations to seat each push pin into the holes in the door inner panel.
2. Position the inside door handle and trim cup to the door and install the retaining nuts.

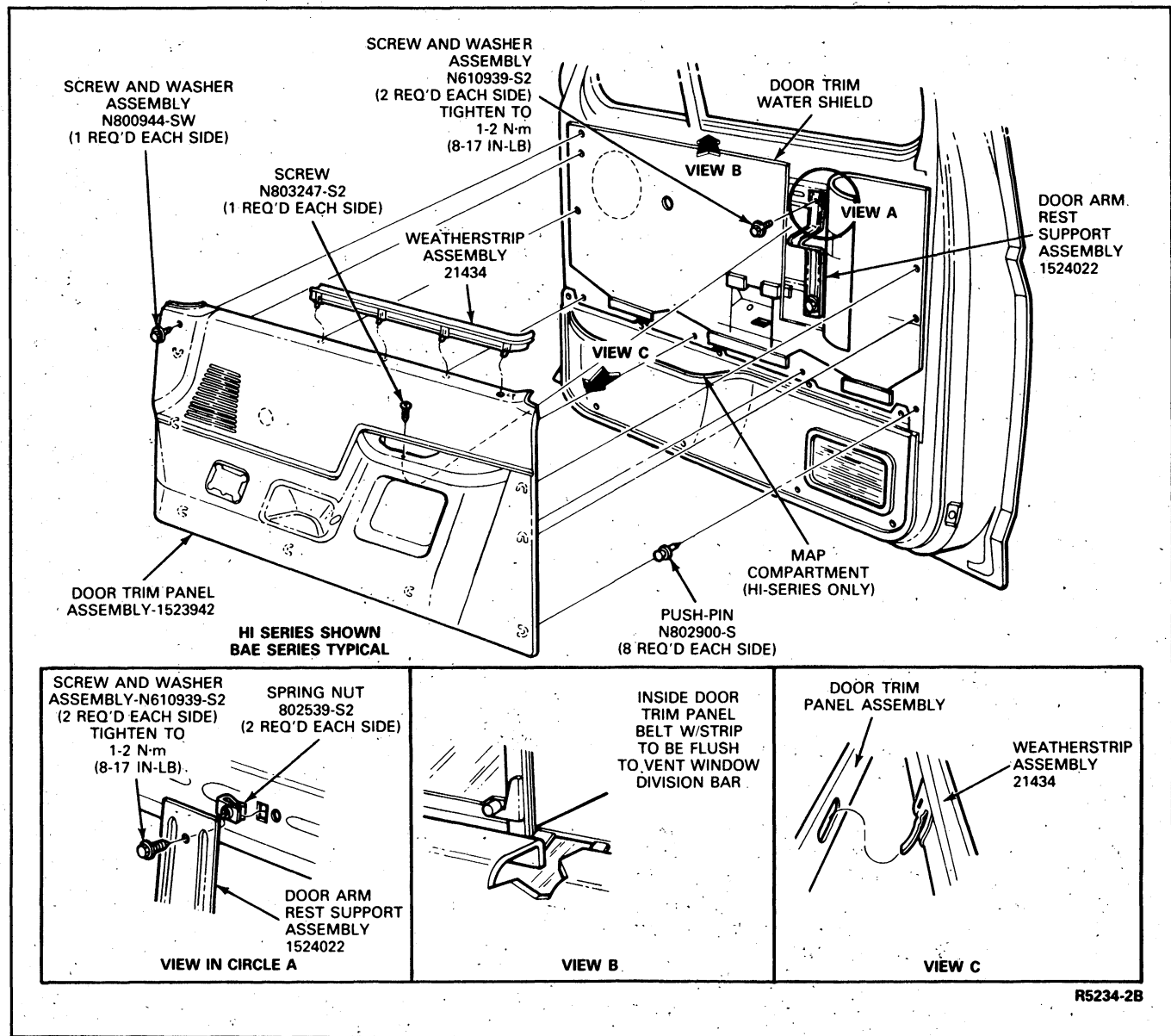


FIG. 1 Bronco, F-150—F-350 and F-Super Duty Truck Door Trim Panel Installation

3. If the vehicle is equipped with stereo radio, position the speaker grille and install the retaining screws.
4. Position the window regulator handle and washer to the window regulator and install retaining screw.
5. Install the armrest to the door inner panel.

### Sliding Door Trim Panel

#### E-150—E-350 Cargo Van

Remove the sliding door trim panel retaining screws and remove the panel (Fig. 6). Position replacement panel to door assembly and install retaining screws.

#### E-150—E-350 and Club Wagon

#### Removal

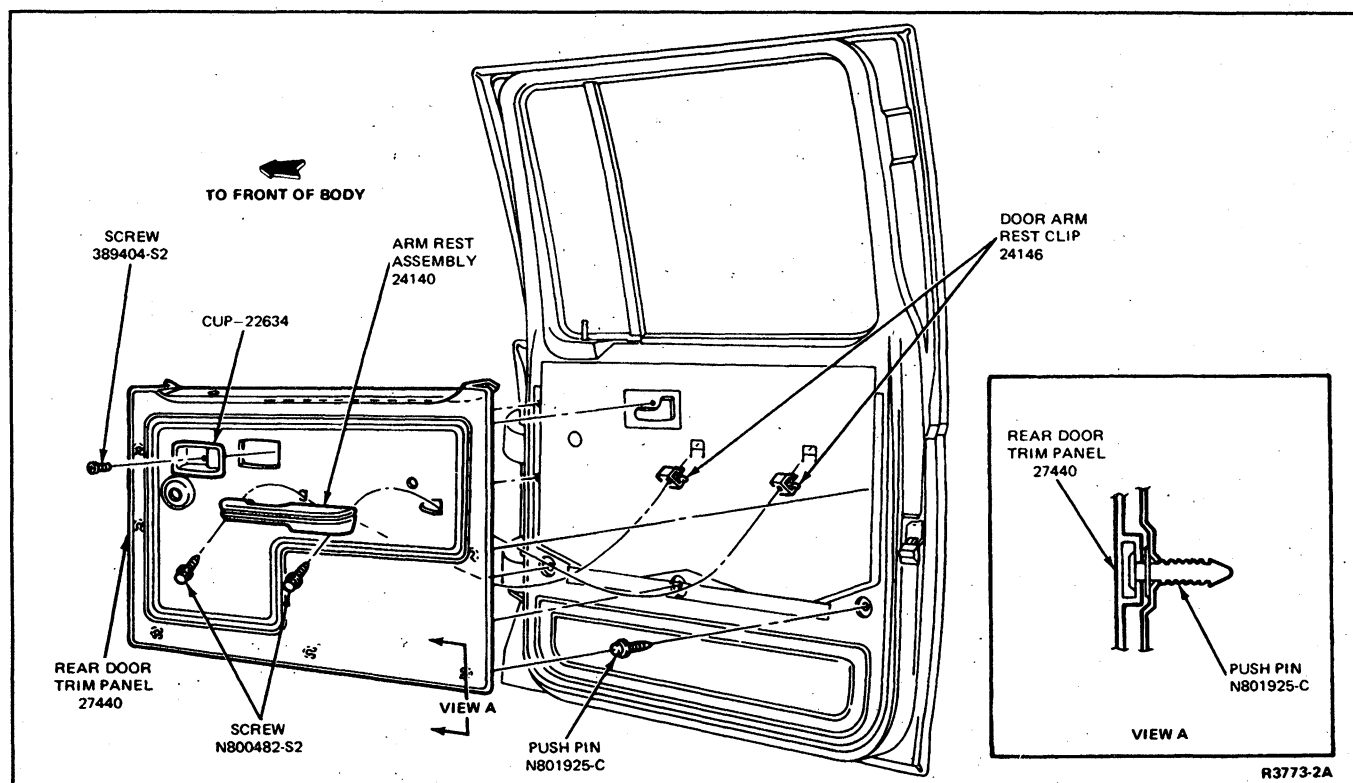
1. Carefully pry the two pull strap end caps off with a small screwdriver.
2. Remove the pull strap retaining screws and pull strap. The pull strap screws remain attached to the pull strap.

3. Disengage the door trim panel push pins individually from the attaching holes in the door inner panel using the Trim Pad Removing Tool from Rotunda Moulding/Trim Kit 107-00401 or equivalent (Fig. 7).

NOTE: At no time should the trim panel be used to pull the push pins from the inner panel holes.

#### Installation

1. Replace any bent, damaged or missing push pins on the trim panel. Position the trim panel to the door inner panel. Position the push pins in the countersunk holes. Firmly push the trim panel at the push pin locations to seat each push pin into the holes in the door inner panel.
2. Position the pull strap onto the inner panel and tighten the retaining screws.
3. Snap the two end caps into the pull strap assembly.



**FIG. 2 F-350 Crew Cab Rear Door Trim Panel Installation**

### Side and Rear Door Trim Panel

Refer to Figs. 8 and 9.

#### E-150—E-350 Side Hinged Door Trim Panels

Remove retaining screws and trim panel (Fig. 8). Replace any bent, damaged or missing trim clips on the panel. Position replacement trim panel to door assembly and install retaining screws.

#### E-150—E-350—Cargo Van Hinged Door Panels—Rear

Remove retaining screws and panel from door (Fig. 9). Position replacement panel to door assembly and install retaining screws.

#### E-150—E-350 Cargo Vans and Wagons Rear Door Trim Panels

##### Removal

Remove the door trim panel push pins individually from the inner door panel using the Trim Pad Removing

Tool from Moulding/Trim Kit 107-00401 or equivalent (Fig. 10).

**NOTE:** At no time should the trim panel be used to pull the push pins from the inner panel holes.

##### Installation

Replace any bent, damaged or missing push pins on the panel. Position the trim panel to the door inner panel and locate the push pins into the countersunk holes (Fig. 10). Firmly push the trim panel at the push pin locations to seat each push pin into the holes in the door inner panel.

#### E-150—E-350 Super Vans Rear Door Trim Panels

Remove retaining screws and trim panel (Fig. 10). Position replacement trim panel to door assembly and install retaining screws.

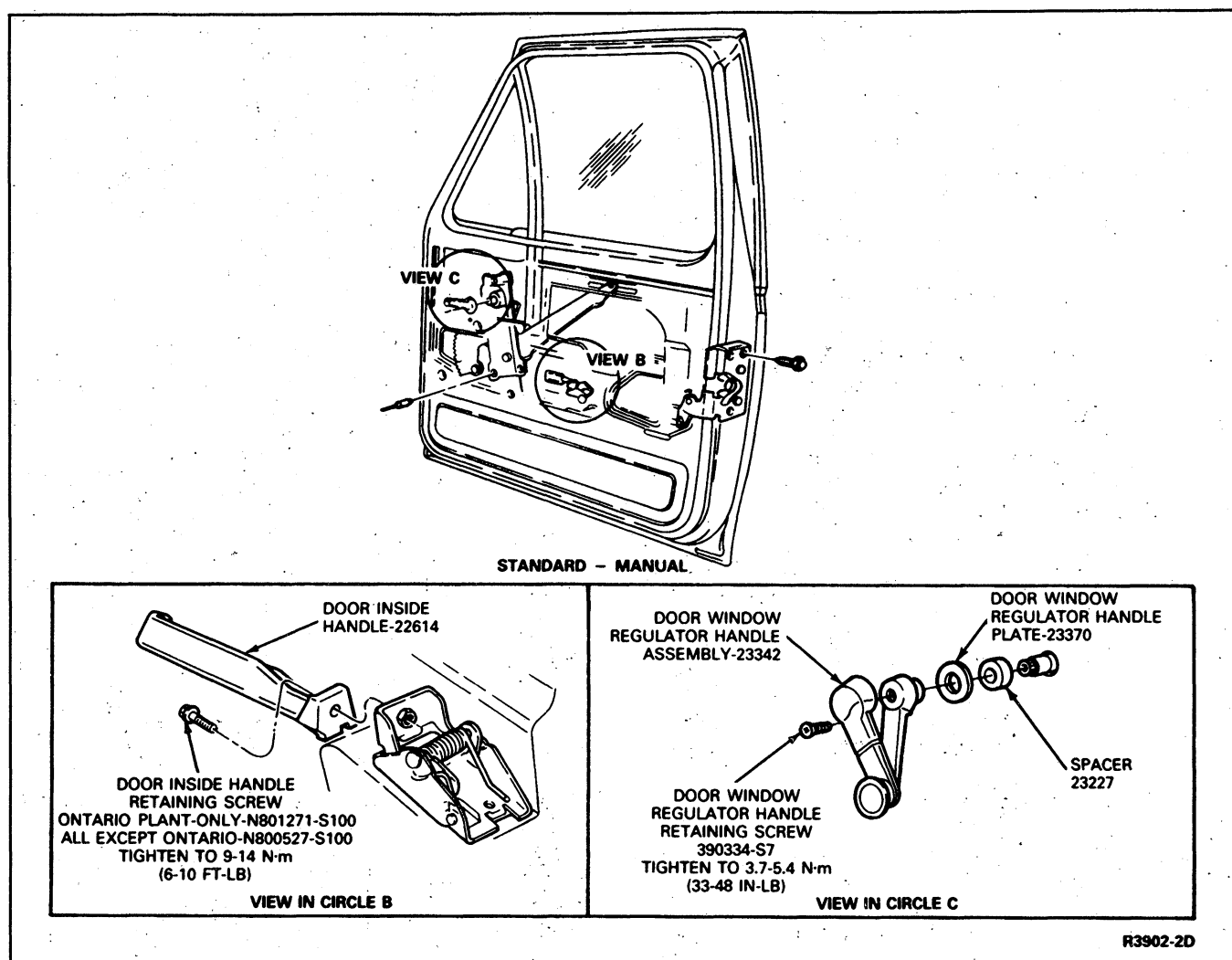


FIG. 3 Door Window Regulator and Inside Handle—F-Series, Bronco

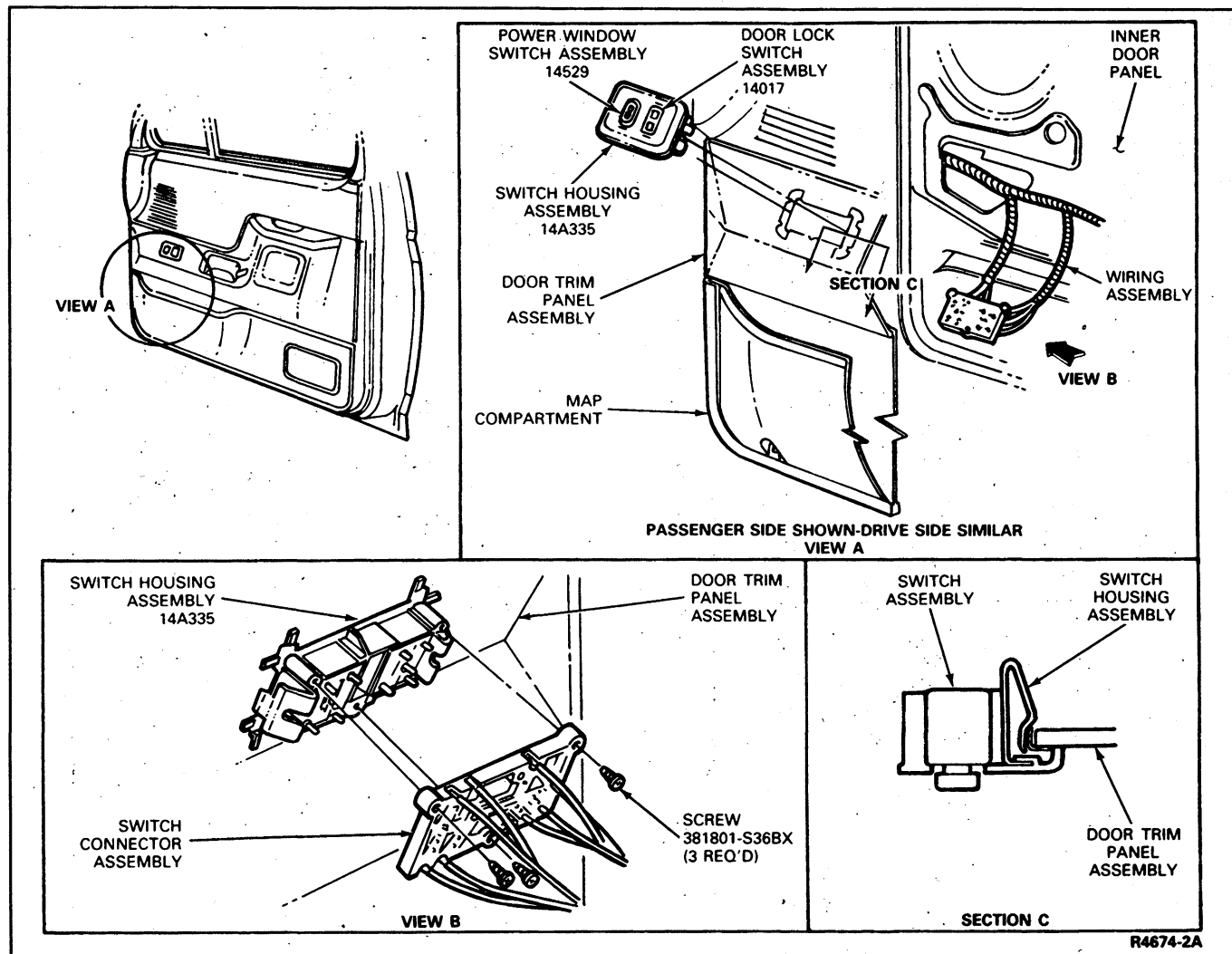


FIG. 4 Power Window and Power Door Lock Switch—F-Series, Bronco

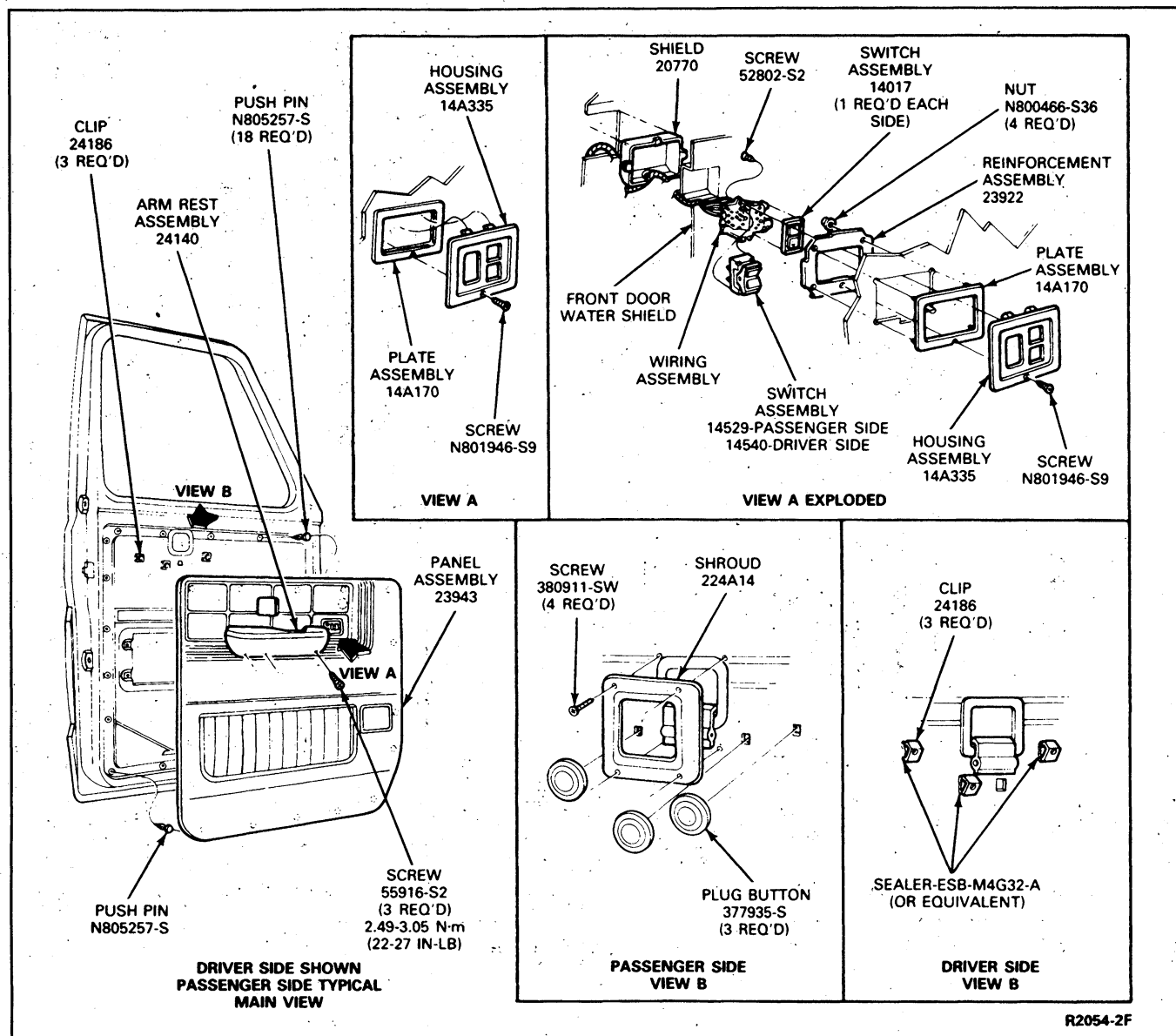


FIG. 5 E-150—E-350 Door Trim Panel Installation

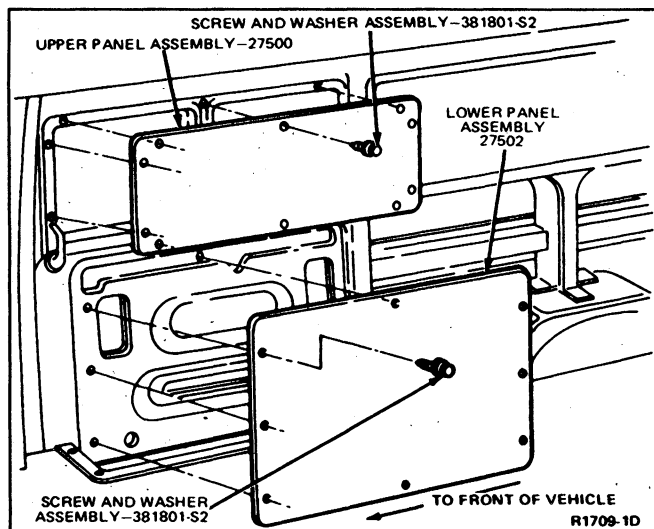


FIG. 6 Sliding Cargo Door—Trim Panel—E-150—E-350

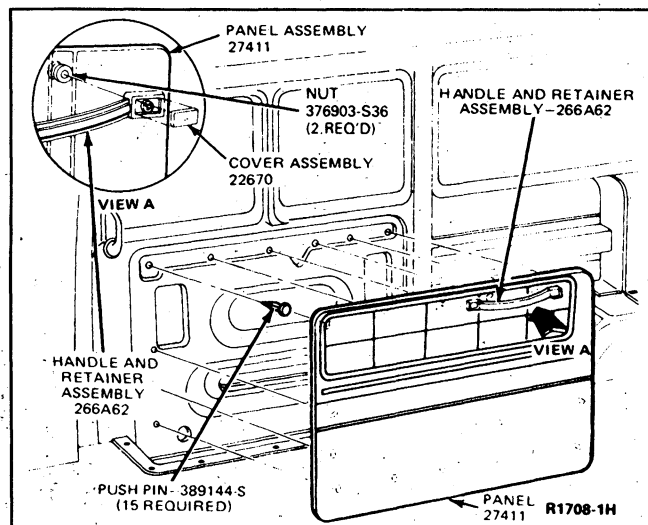


FIG. 7 Sliding Cargo Door—Trim Panel—E-150—E-350

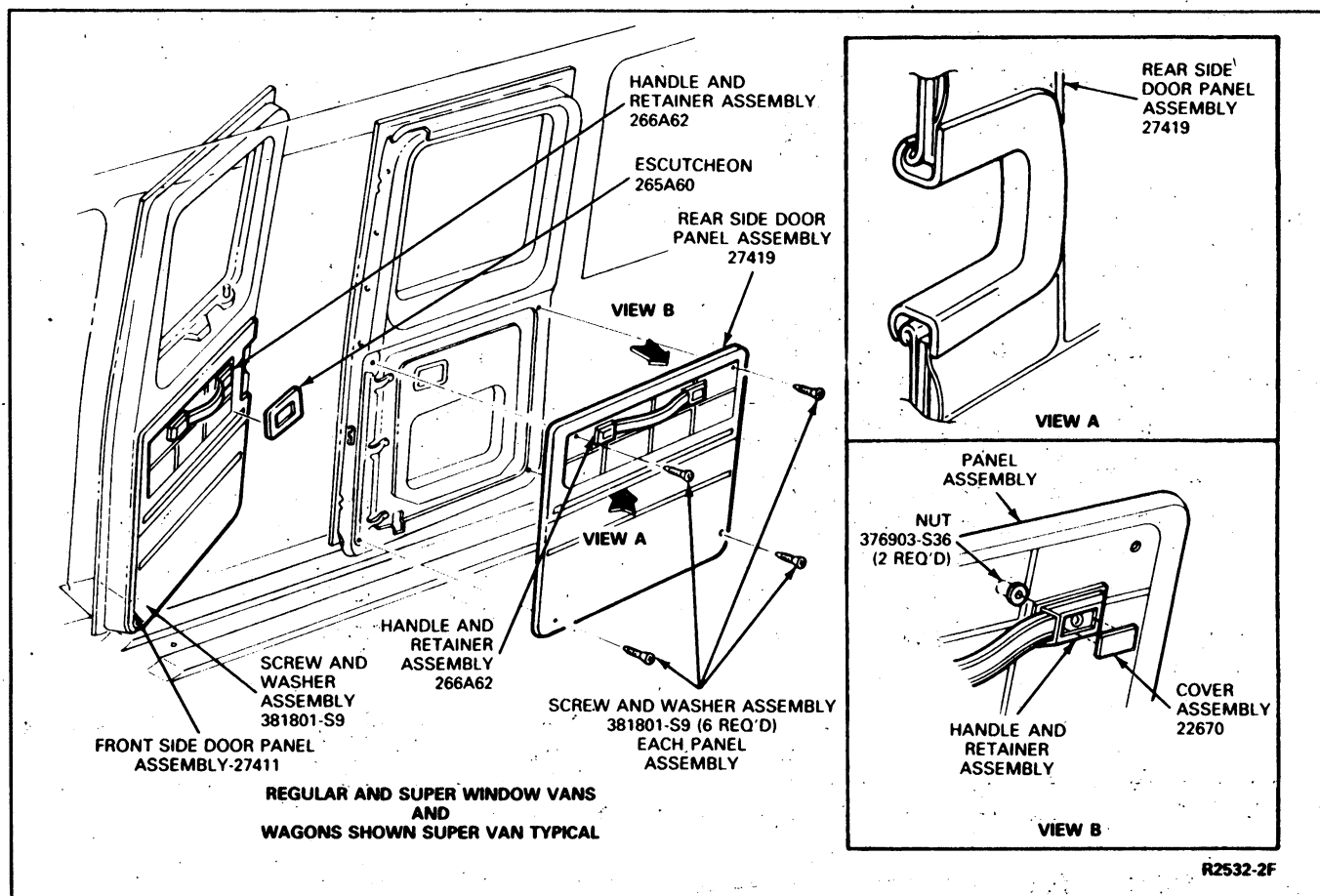


FIG. 8 Side Hinged Door Trim Panel—E-150—E-350

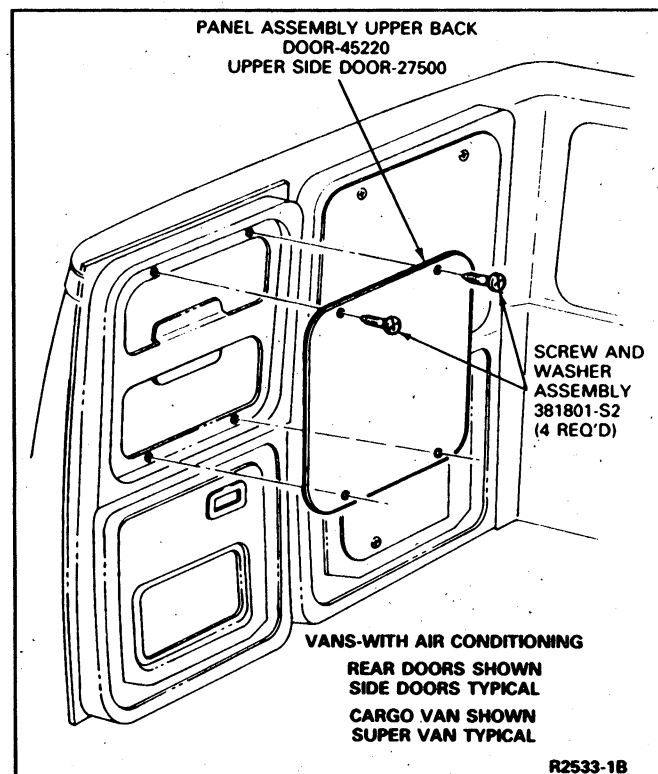


FIG. 9 Cargo Van Hinged Door Panel—Rear



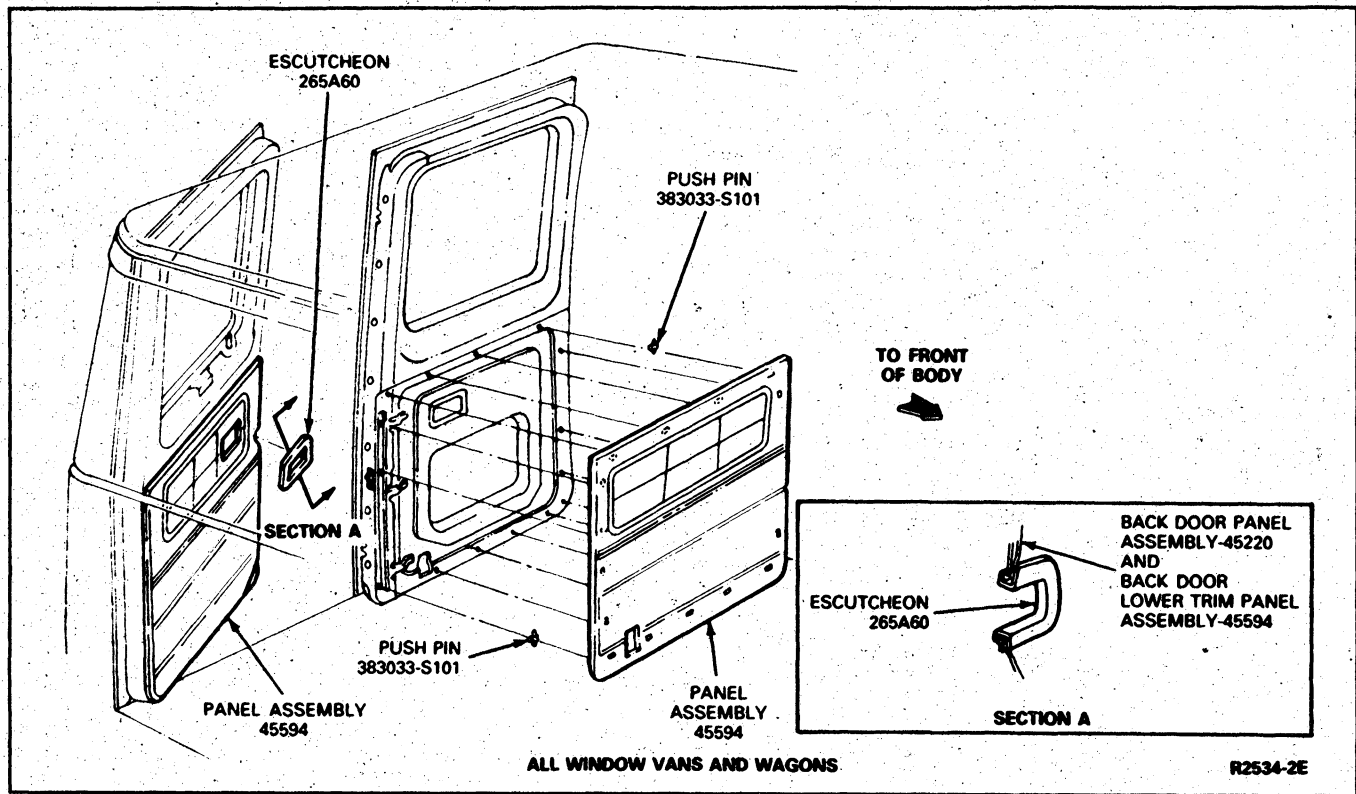


FIG. 10 Rear Door Trim Panel—E-150—E-350 Cargo Vans and Wagons

### SPECIAL SERVICE TOOLS

#### ROTUNDA EQUIPMENT

Model	Description
107-00401	Molding/Trim Kit

CR4673-1A

## SECTION 45-11 Interior Trim Panels

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Quarter Trim Panel .....	45-11-1	Side Trim Panels (Cont'd)	
E-150—E-350 .....	45-11-1	F-150—F-350 .....	45-11-1
Side Trim Panels .....	45-11-1	<b>SPECIAL SERVICE TOOLS</b> .....	45-11-1
Bronco .....	45-11-1	<b>VEHICLE APPLICATION</b> .....	45-11-1

### VEHICLE APPLICATION

E-150 Through E-350, F-150 Through F-350, F-Super Duty and Bronco.

### REMOVAL AND INSTALLATION

Since all interior trim panels are retained to the body panels with screws and/or metal strips, the removal and installation procedures are obvious, as shown in the assembly illustrations. Trim panels and retainers are shown in Figs. 1 through 24. Access to some of these panels, however, requires prior removal of other parts. Applicable removal procedures are outlined as follows:

#### Quarter Trim Panel

##### E-150—E-350

Refer to Figs. 1 through 16.

Before removing the LH side trim panel, adjust the driver's seat forward.

Before removing the RH side trim panel, remove the right seat assembly from the vehicle. Refer to Group 41.

#### Side Trim Panels

Front Trim Panel, LH Side—Remove the first bench seat and window garnish moulding. Refer to Group 41.

Right Trim Panel, RH side—Remove the two rear bench seats, the spare tire, and window garnish moulding. Refer to Group 41.

Rear Trim Panel, LH side—Remove the two rear bench seats and window garnish moulding. Refer to Group 41.

##### F-150—F-350

Refer to Figs. 17, 18, 19 and 20 for removal and installation of trim panels.

##### Bronco

Refer to Figs. 20 through 24 for removal and installation of trim panels.

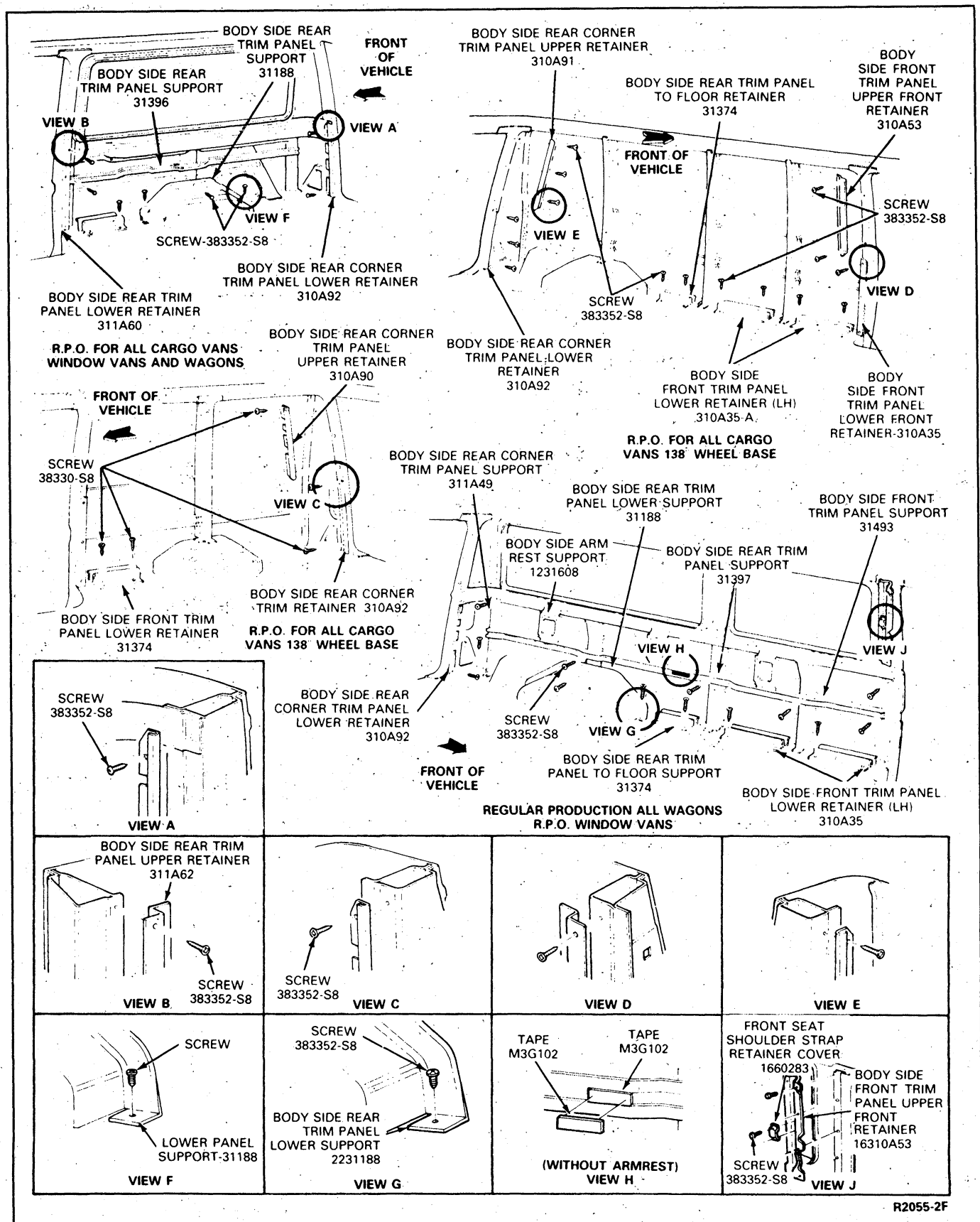
NOTE: When removing panels retained by push pins use the Trim Pad Removing Tool from Rotunda Moulding/Trim Kit 107-00401 or equivalent to carefully pry trim panel from inner panel. Replace any bent, damaged or missing push pins.

### SPECIAL SERVICE TOOLS

#### ROTUNDA EQUIPMENT

Model	Description
107-00401	Molding/Trim Kit

CR4673-1A



R2055-2F

FIG. 1 Trim Panel Retainers and Supporters—E-150—E-350 and Club Wagon—138-Inch W.B.

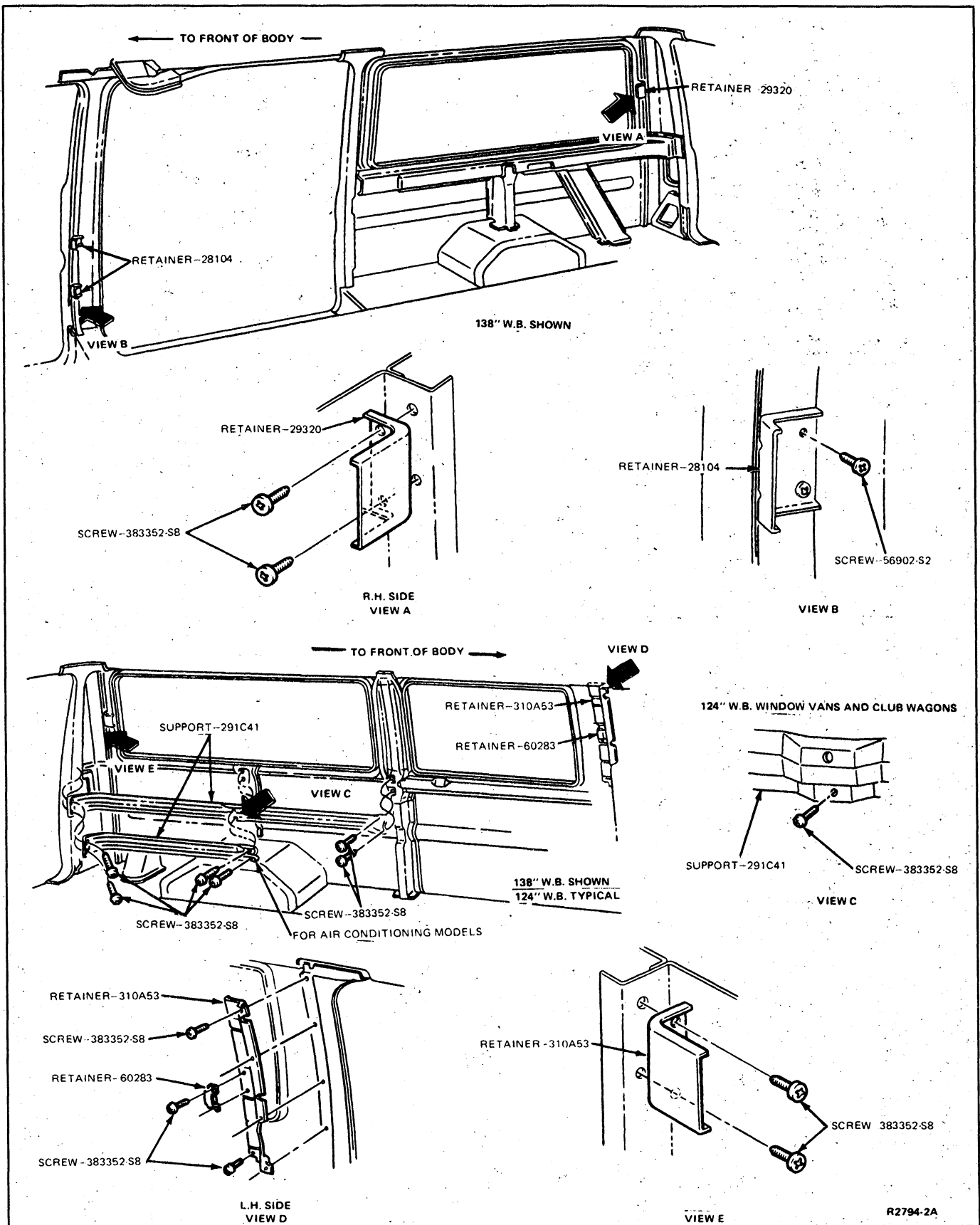
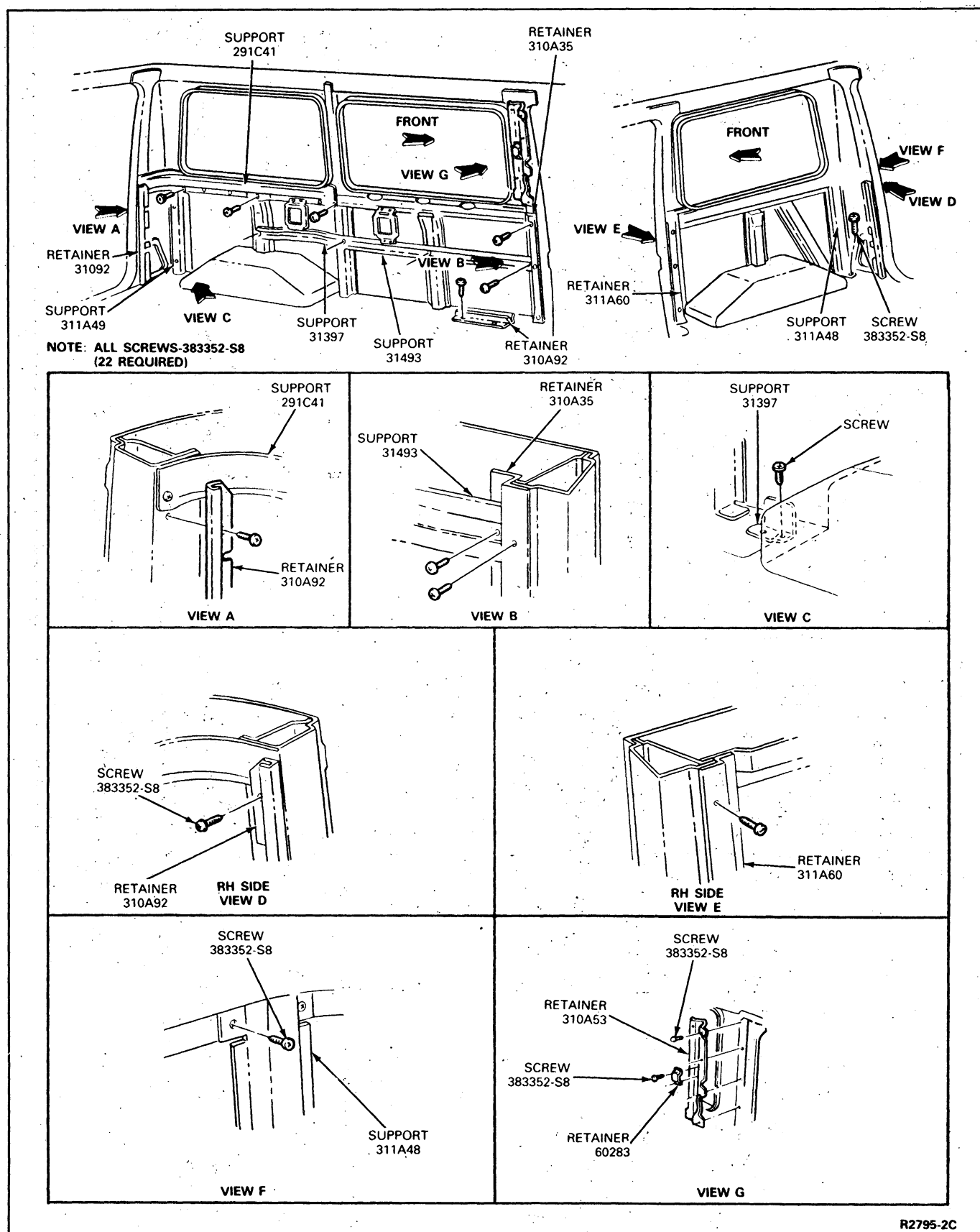


FIG. 2 Interior Moulding Supports—E-150—E-350



R2795-2C

FIG. 3 Trim Panel Retainer and Supports—E-150—E-350—124 Inch W.B.

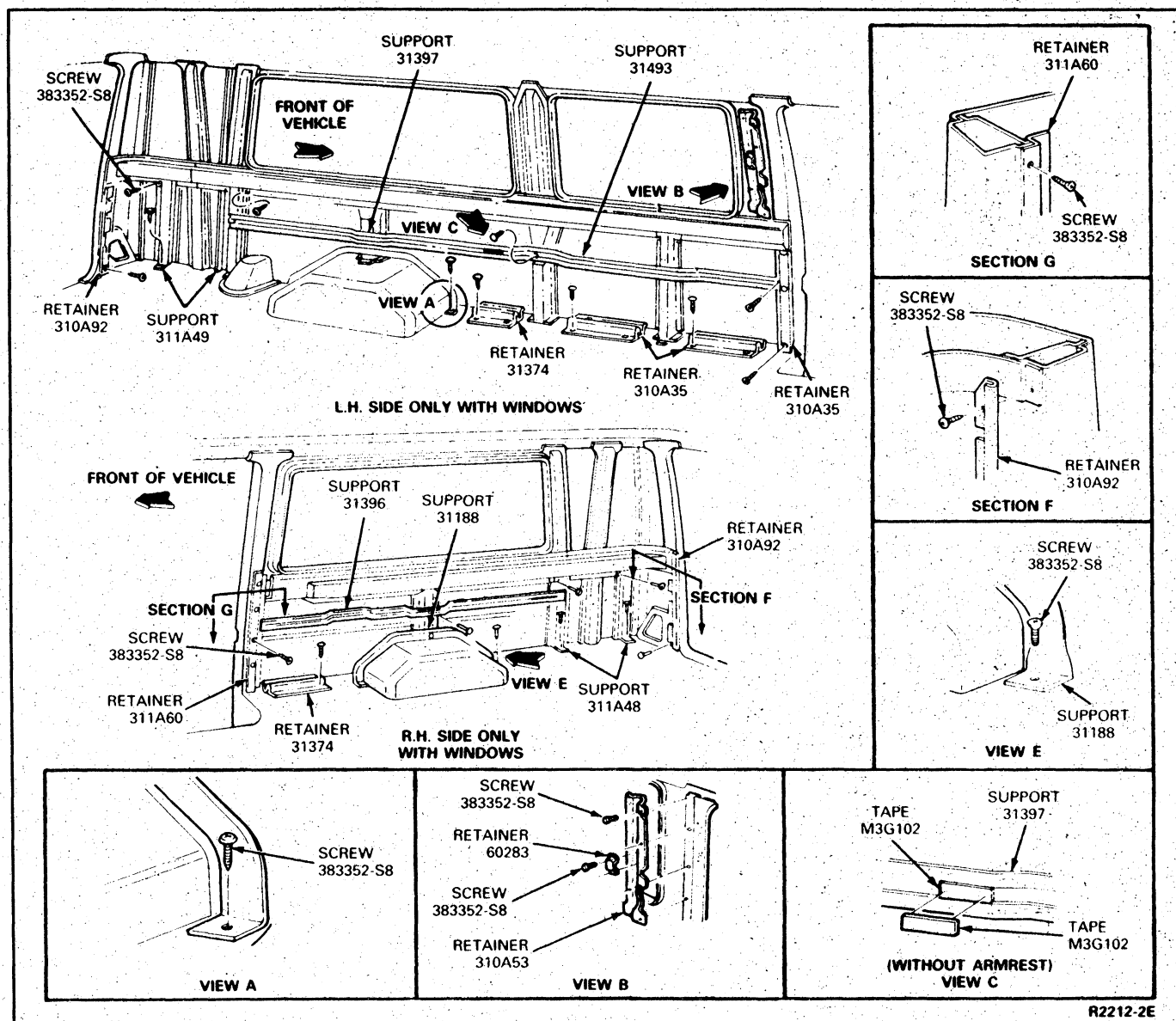


FIG. 4 Trim Panel Retainers and Supports—E-150—E-350 Super Wagon

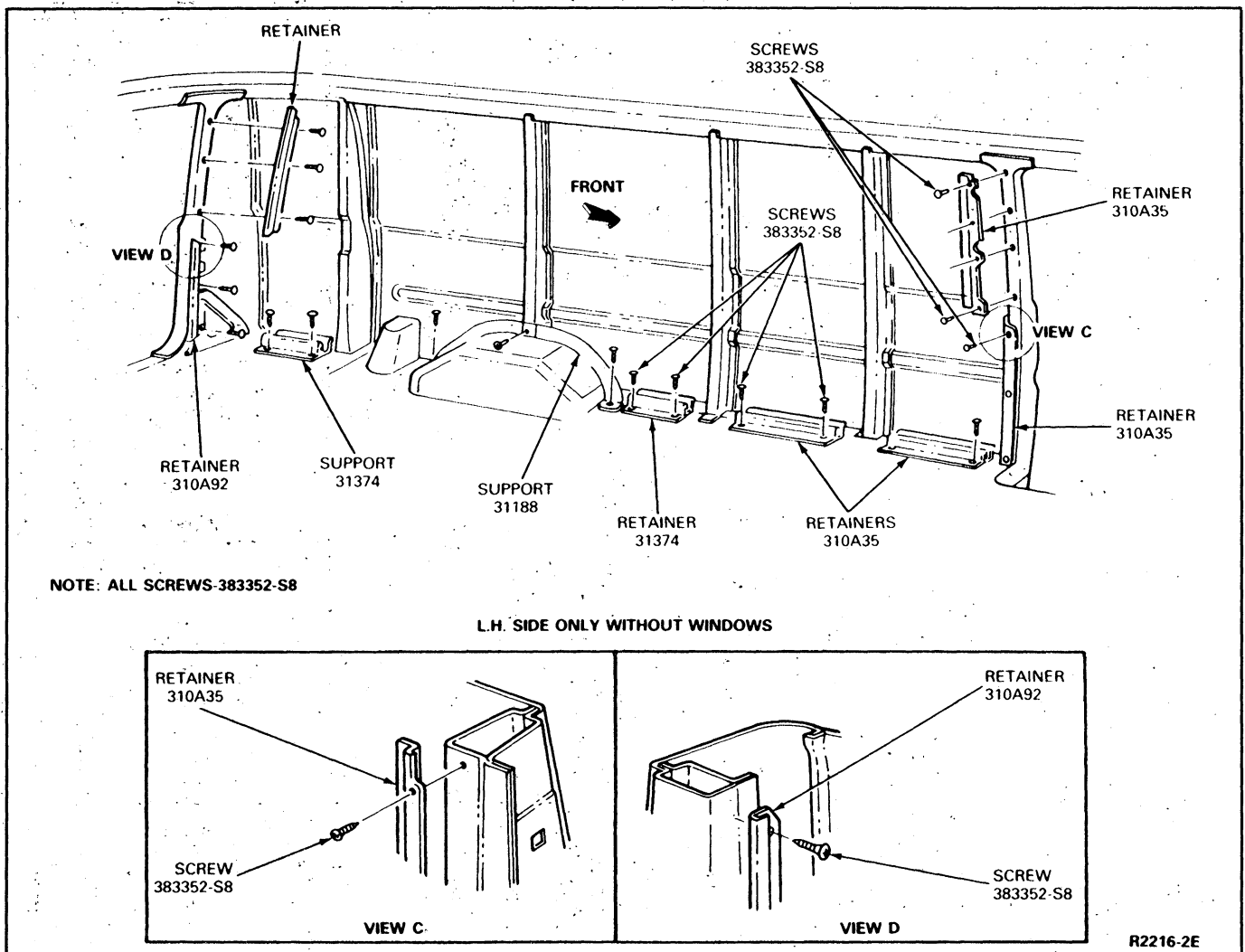


FIG. 5 Trim Panel Retainers and Supports—E-150—E-350 Super Van

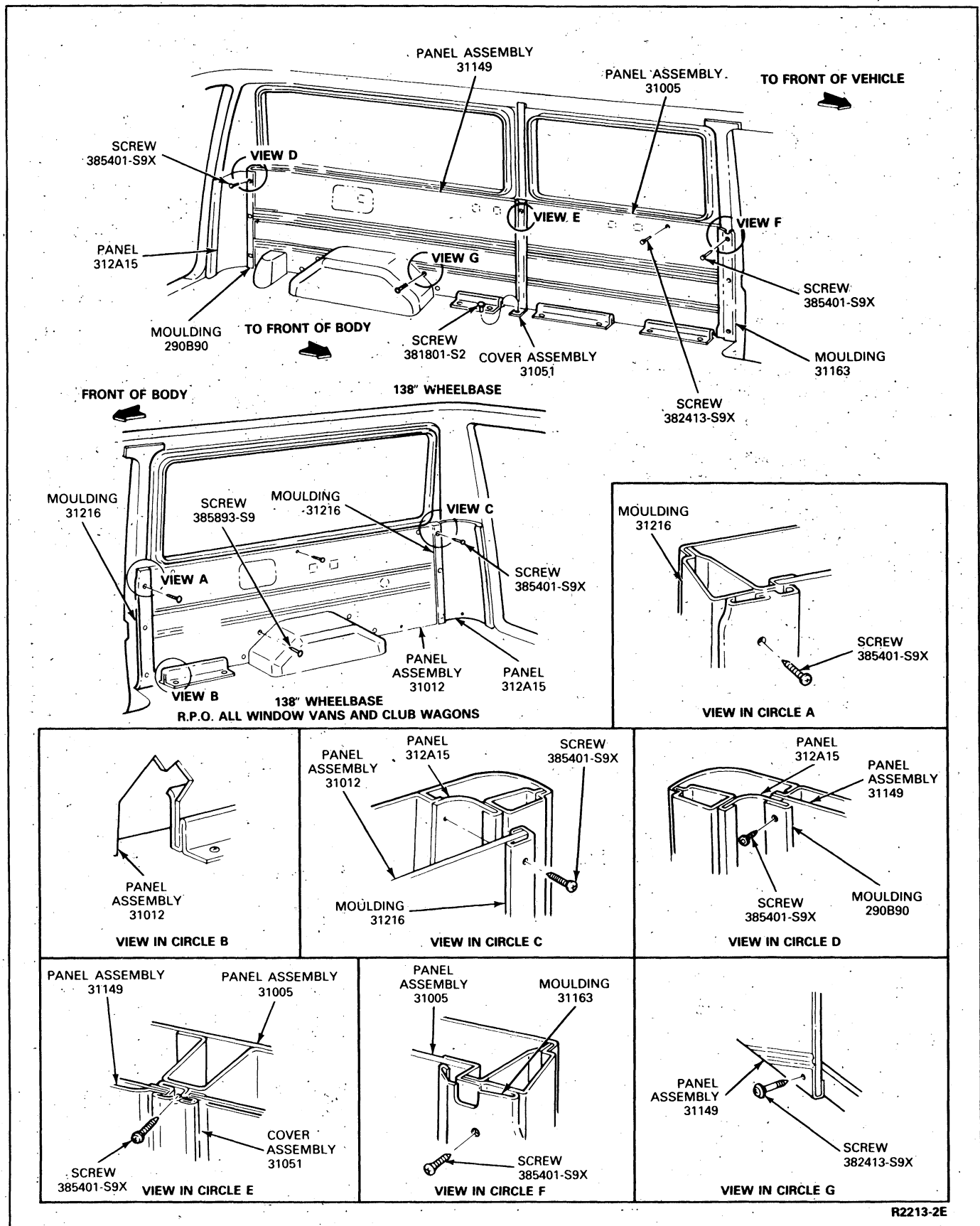


FIG. 6 Trim Panel and Mouldings—E-150—E-350



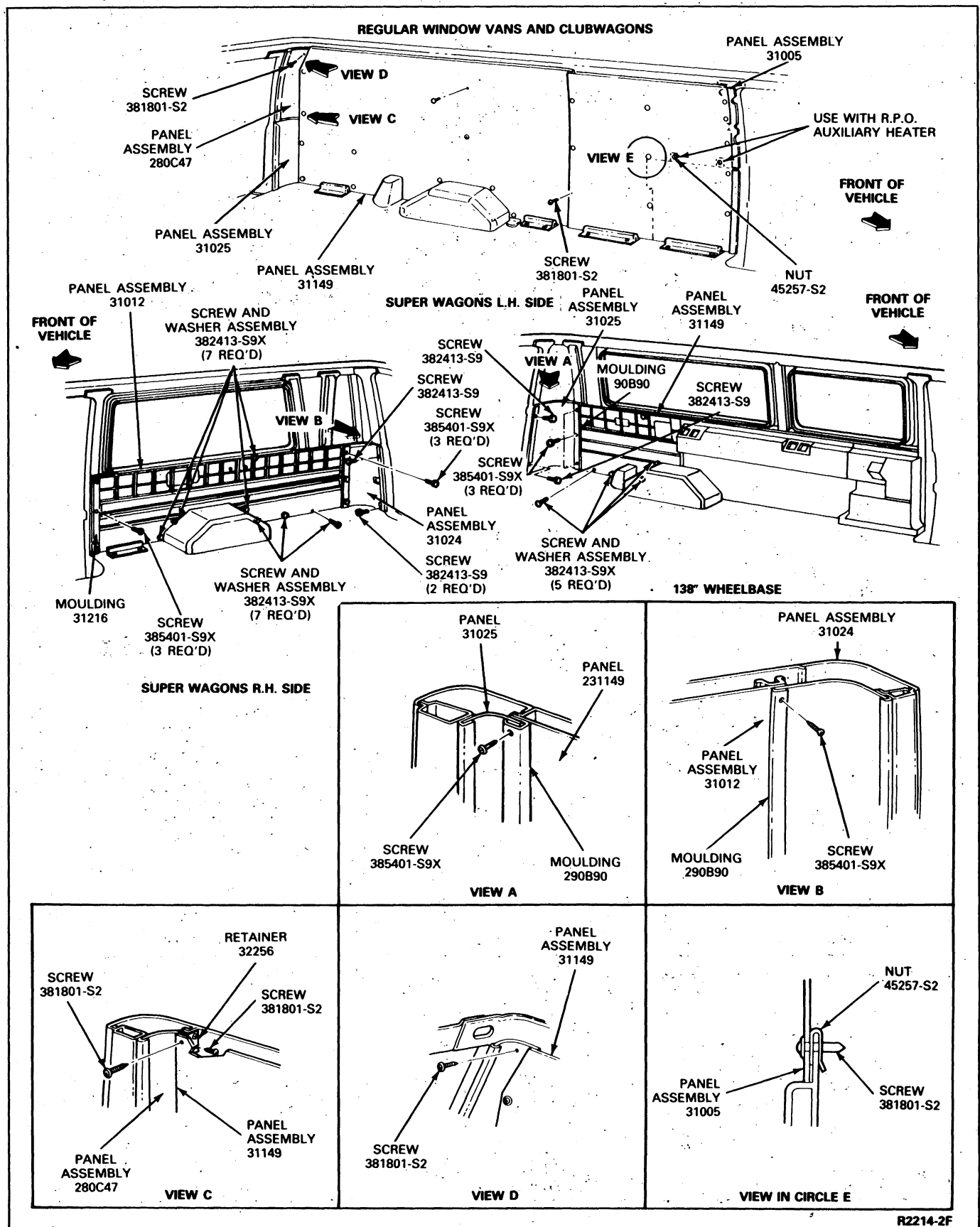


FIG. 7 Trim Panels—E-150—E-350

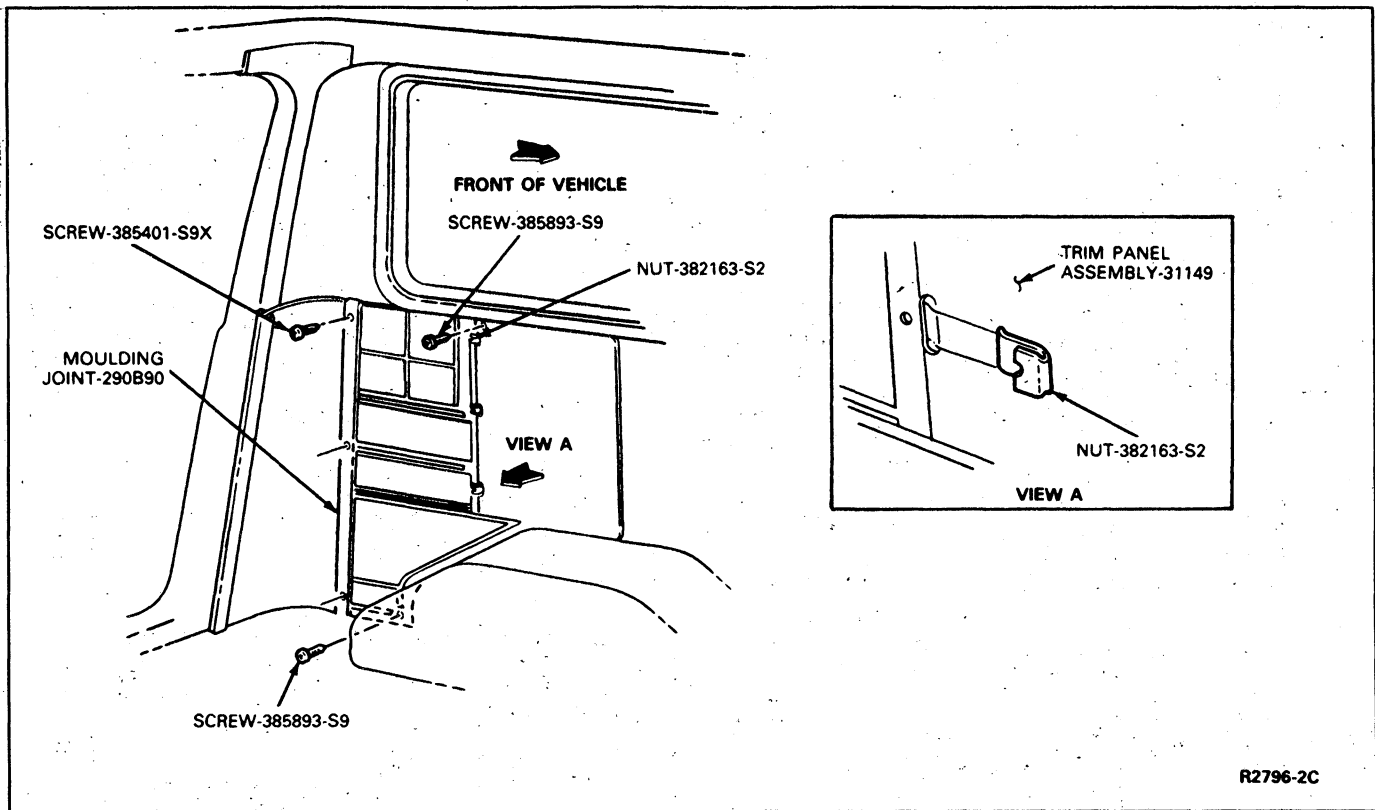
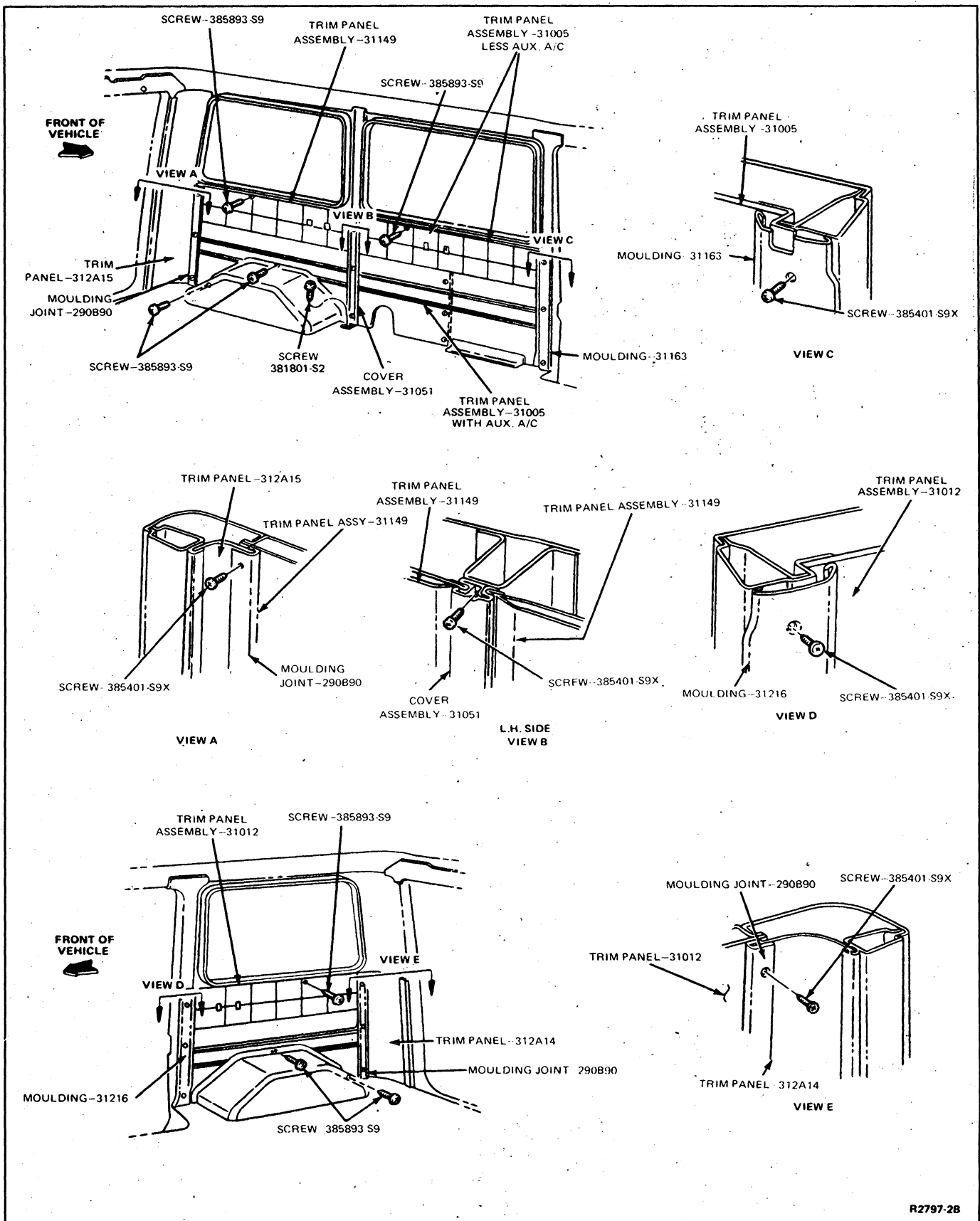


FIG. 8 Rear Trim Panel—E-150—E-350—124-Inch W.B.



R2797-28

FIG. 9 Trim Panels—E-150—E-350 Window Vans and Wagons—124-Inch W.B.

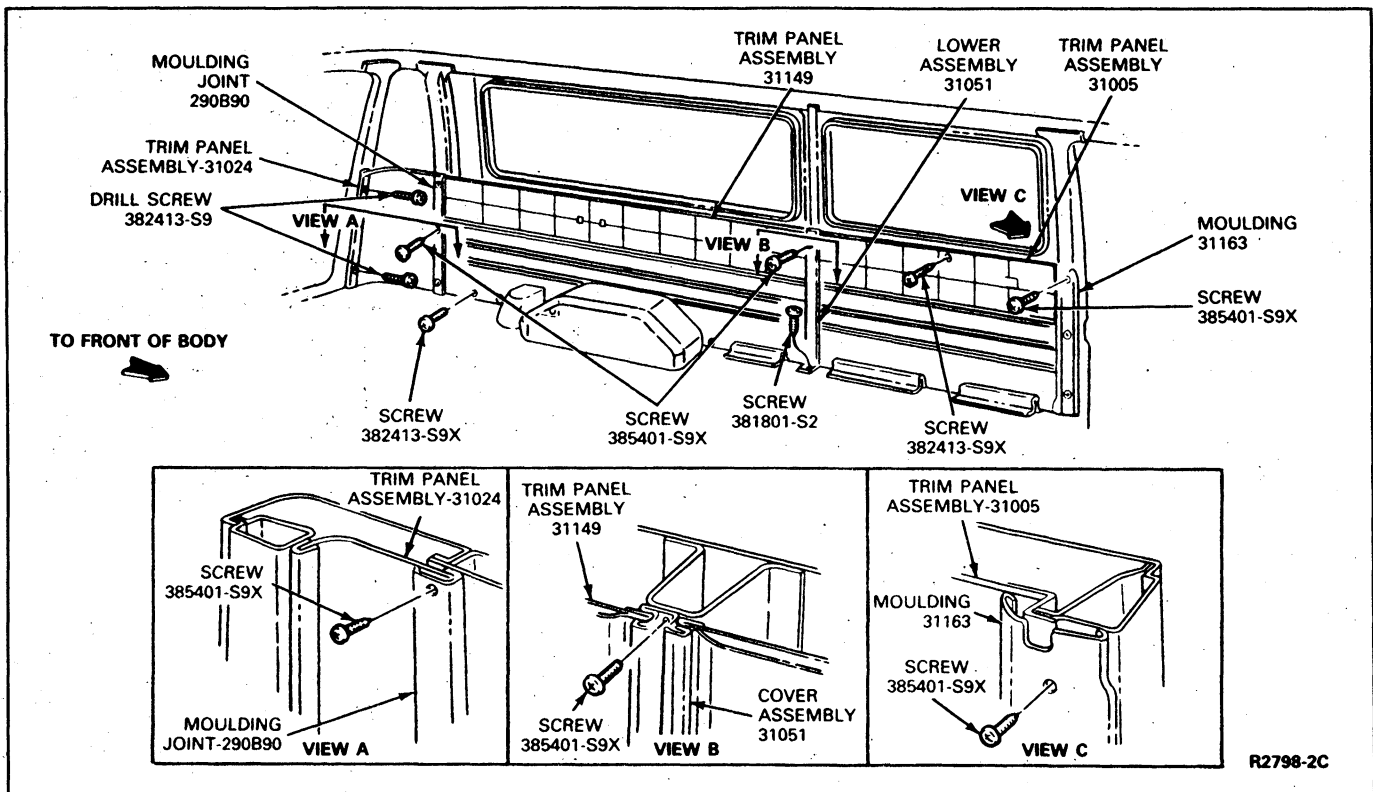


FIG. 10 Super Wagon Trim Panels—E-150—E-350 (L.H. Side Shown, R.H. Side Similar)

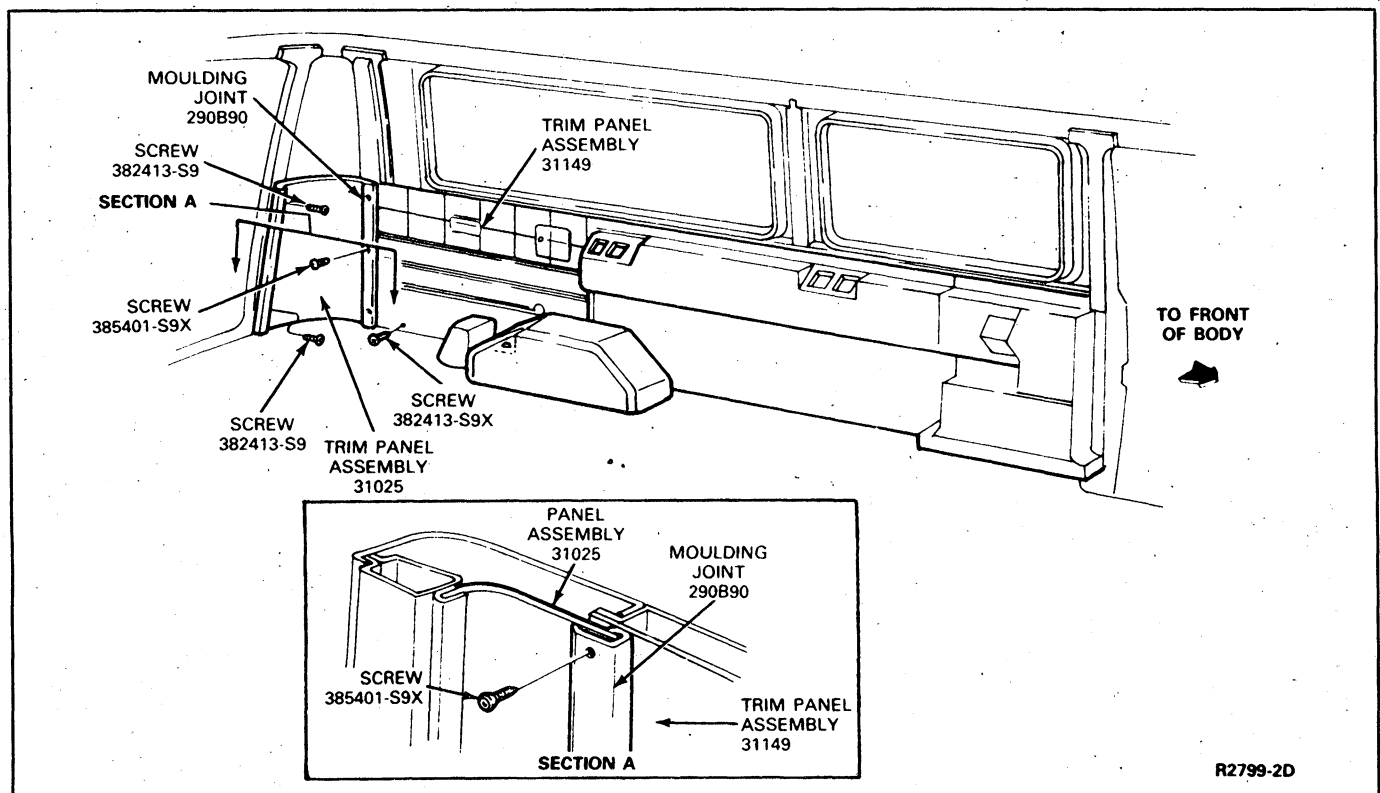


FIG. 11 Super Wagon (w/A/C) Trim Panels—E-150—E-350 (L.H. Side Shown)

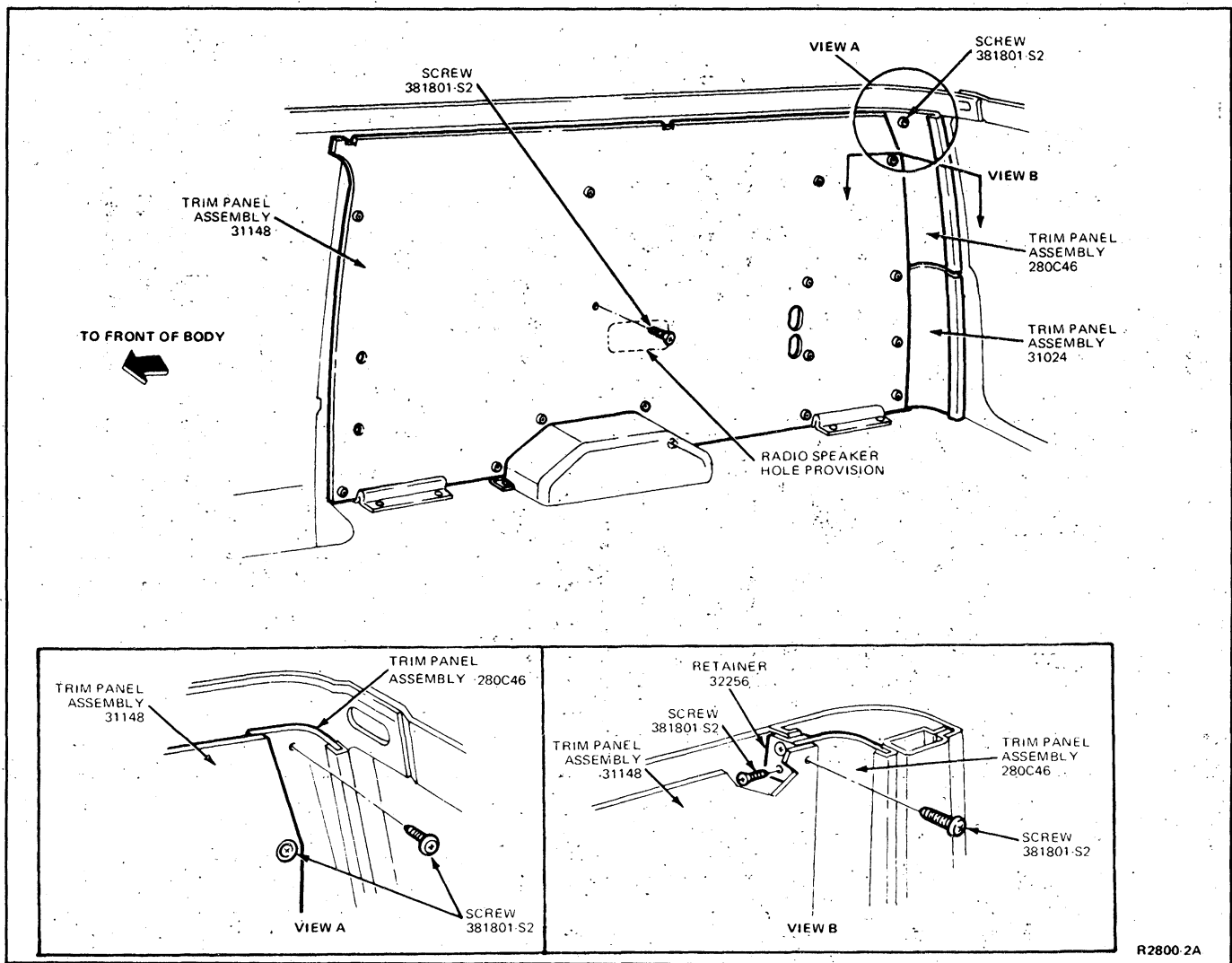


FIG. 12 Super Van Trim Panels—E-150—E-350



**FIG. 13 Quarter Trim Armrest—E-150—E-350**

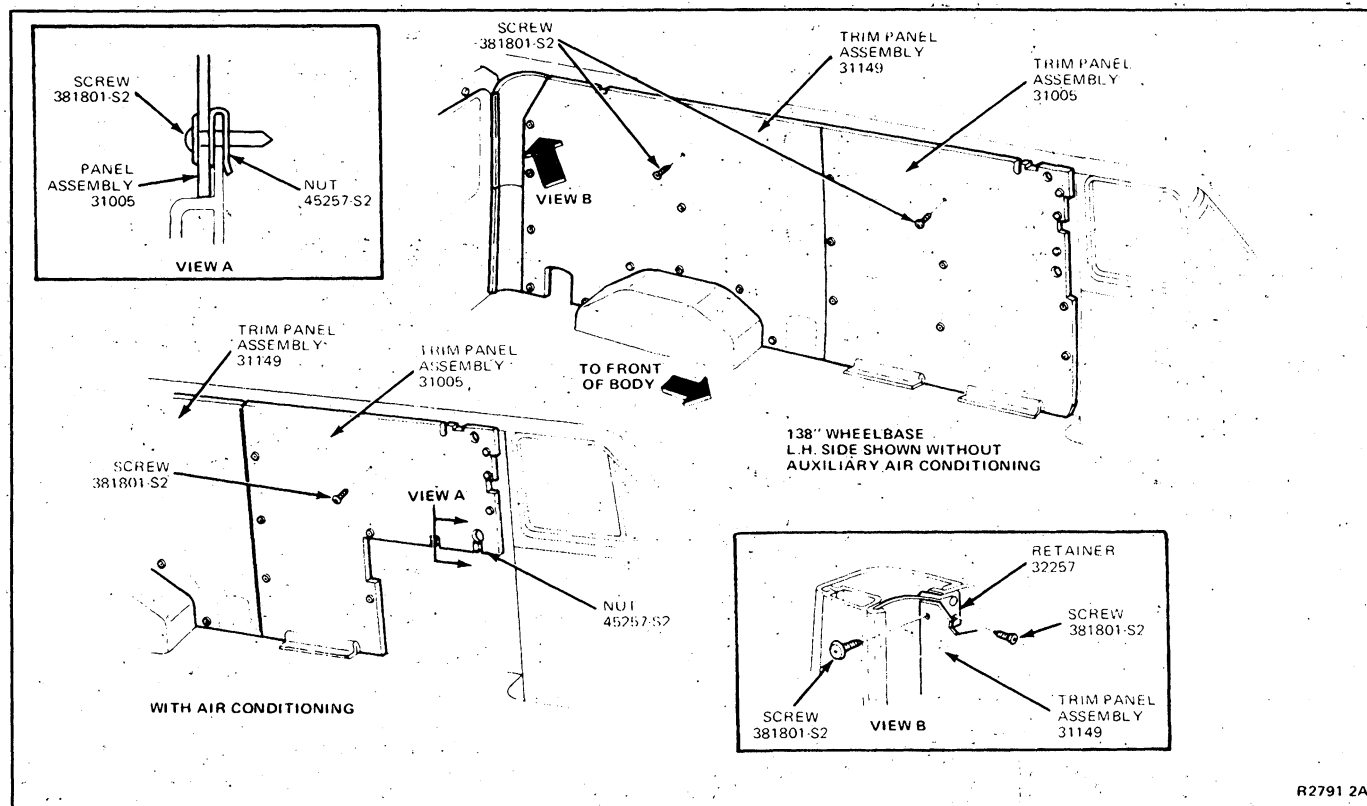


FIG. 14 Body Side Trim Panels—E-150—E-350 Vans (L.H. Side Shown, R.H. Side Similar)

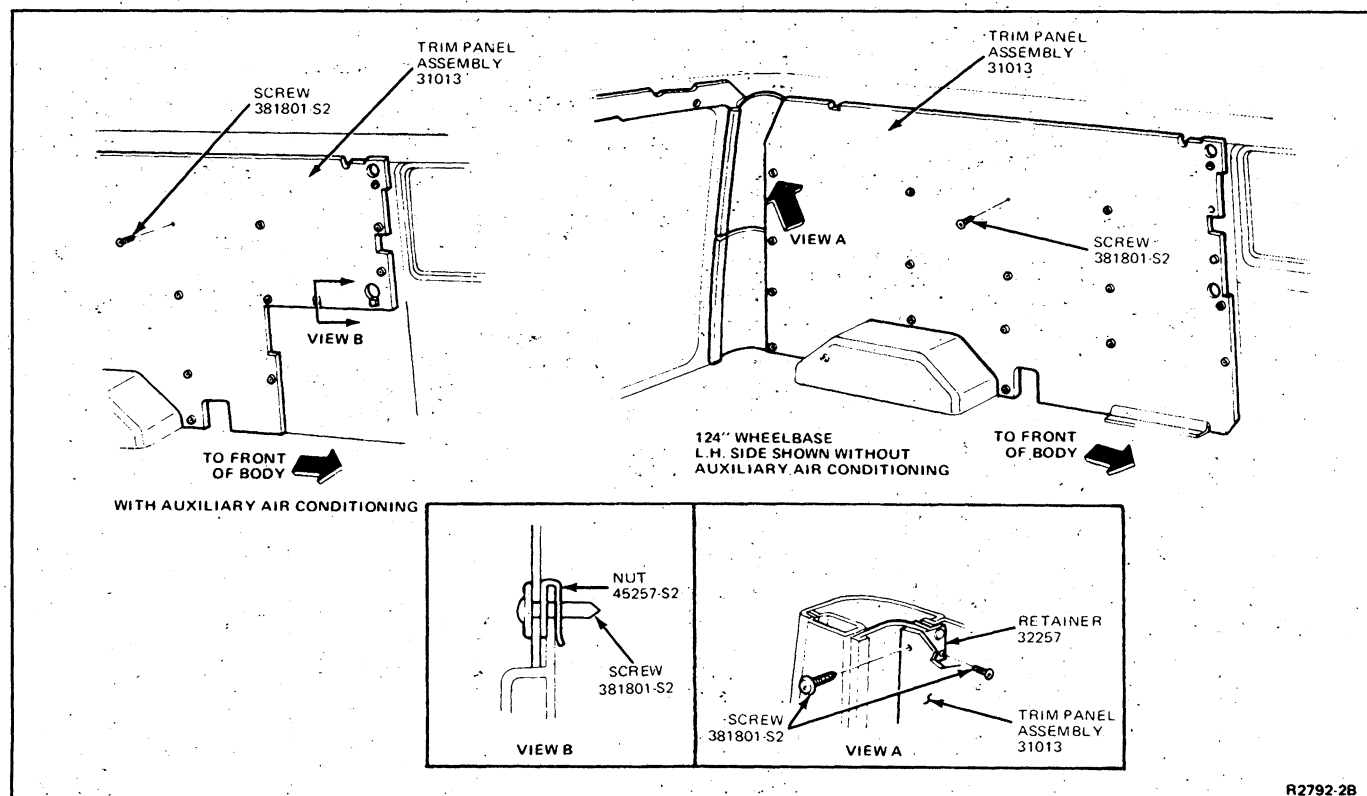


FIG. 15 L.H. Side Rear Trim Panels—E-150—E-350 Vans

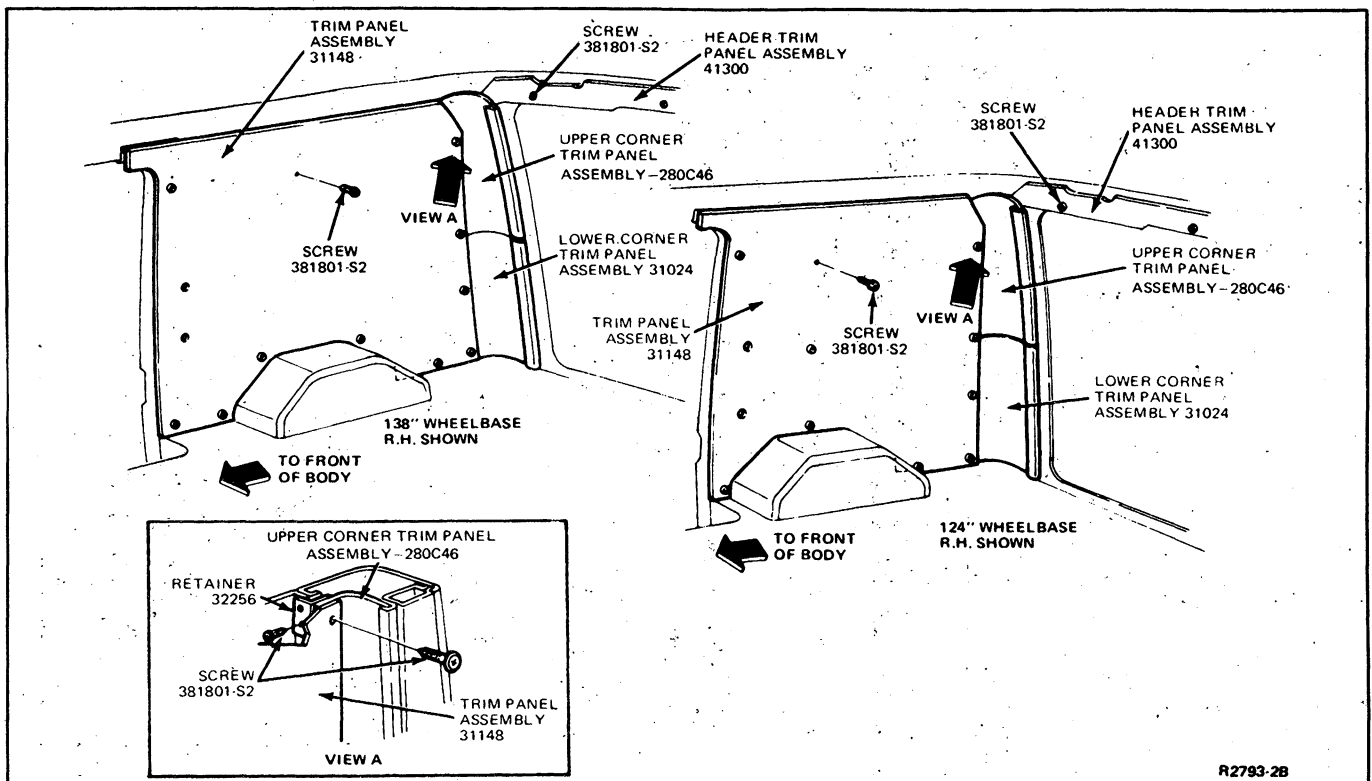


FIG. 16 R.H. Side Rear Trim Panels—E-150—E-350 Vans

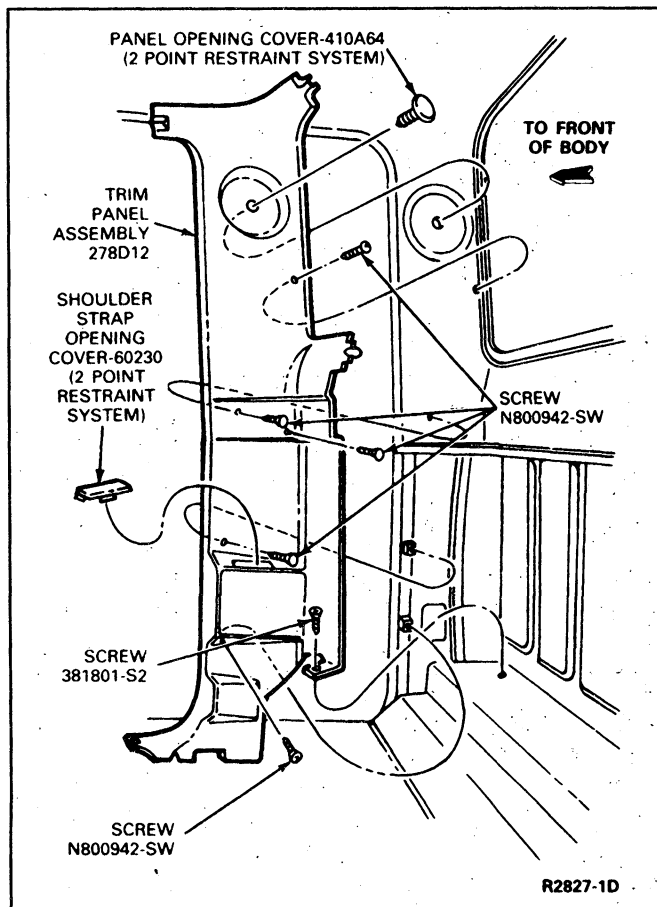


FIG. 17 F-250—F-350 Over 8500 G.V.W. Rear Corner Trim Panels—Regular Cab Shown, Crew Cab Typical



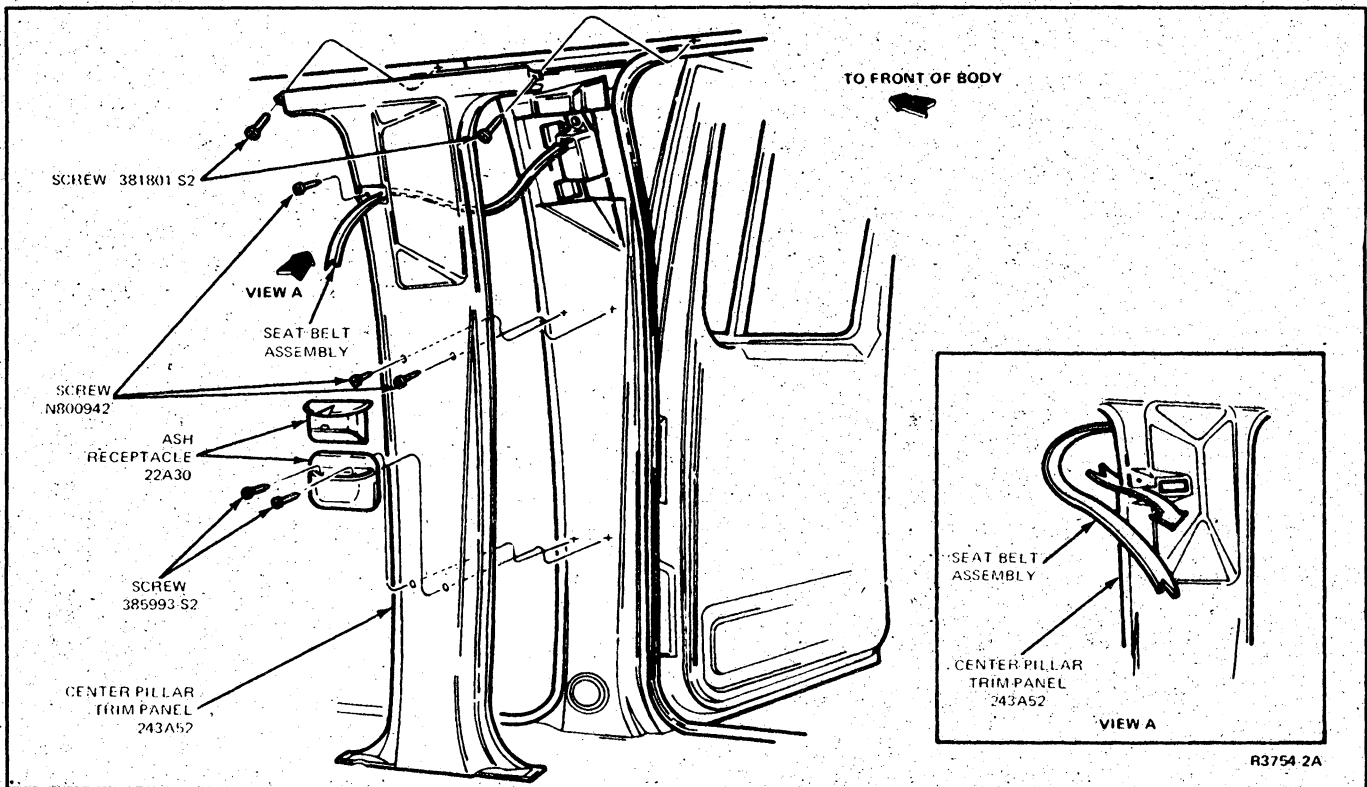


FIG. 18 F-350 Crew Cab Center Pillar Trim Panel

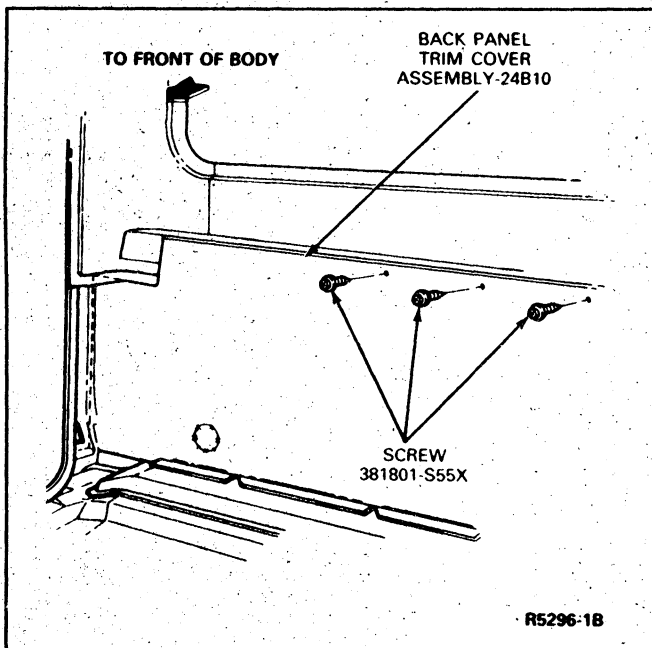


FIG. 19 Back Panel Trim Cover Assembly

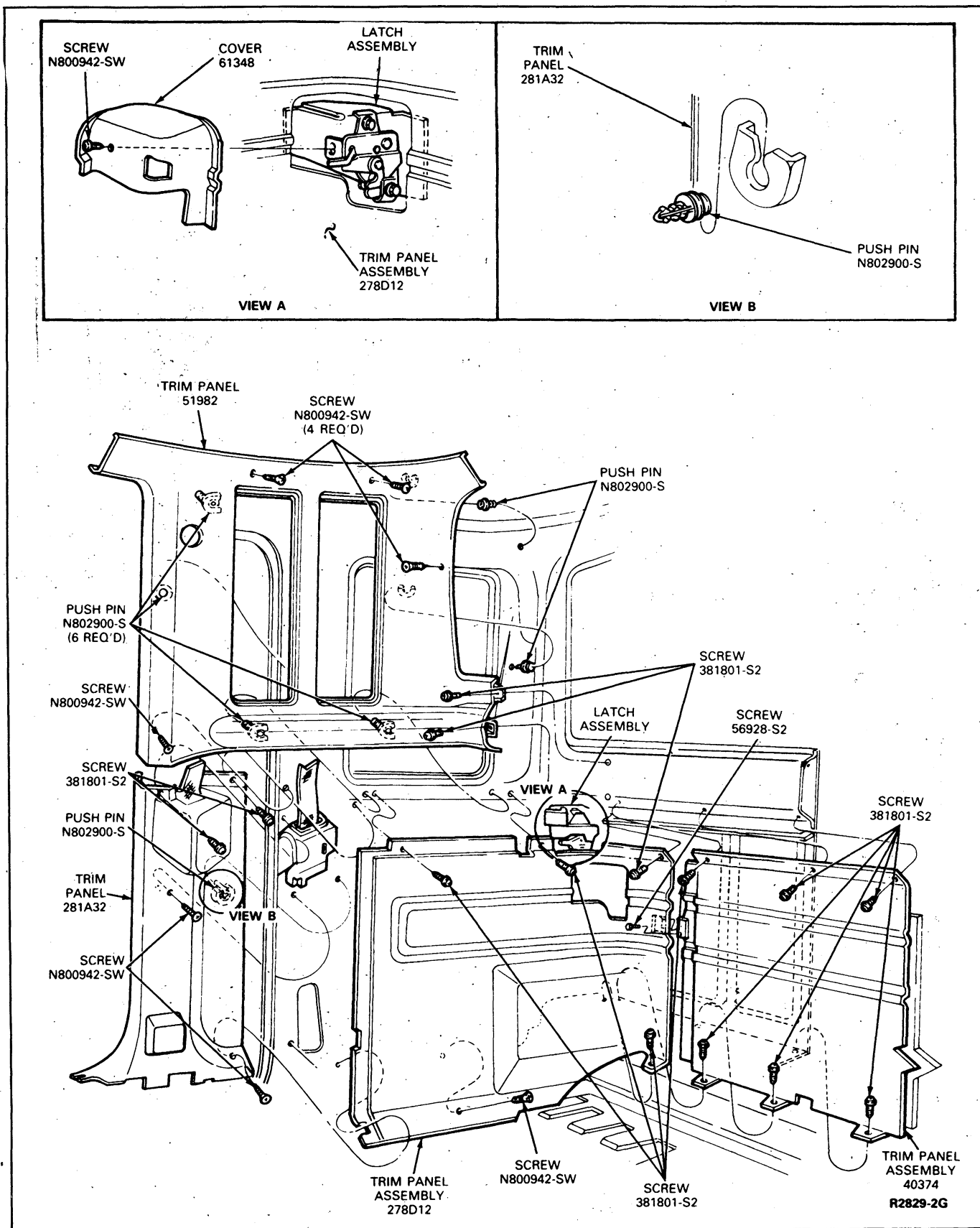


FIG. 20 F-150—F-350 Super Cab Body Trim Panels

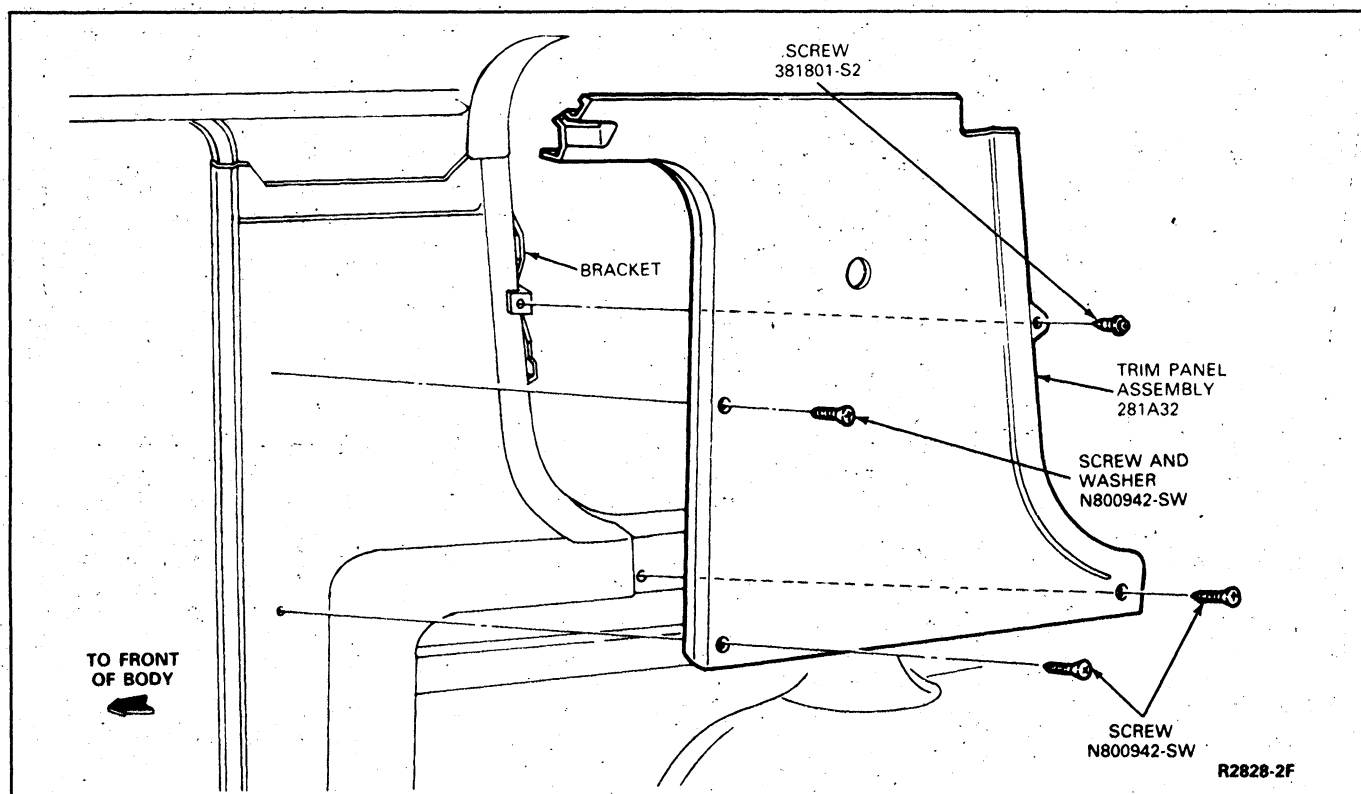


FIG. 21 R.P.O. Bronco Body Trim Panels

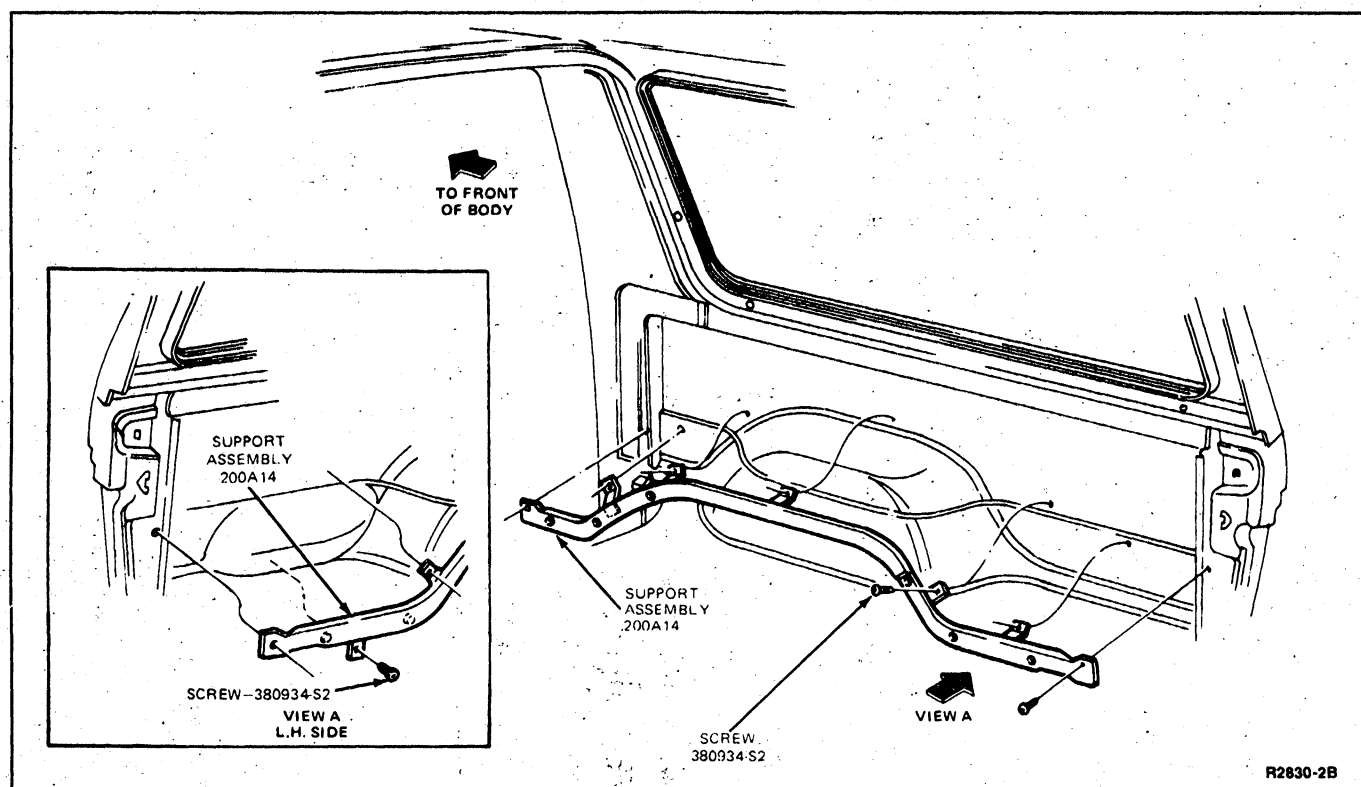


FIG. 22 Bronco Body Side Trim Panel Support

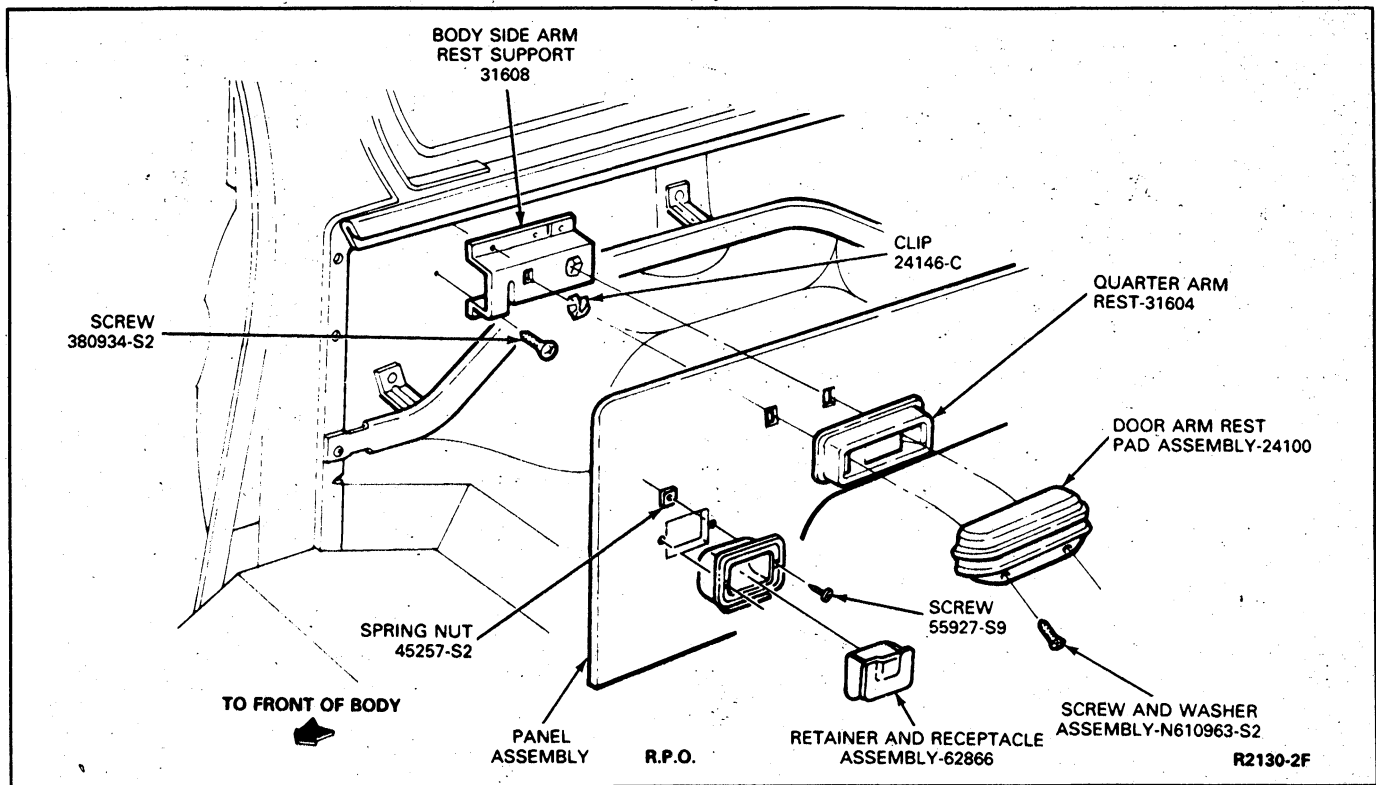


FIG. 23 R.P.O. Body Side Trim Armrest and Ash Receptacle—Bronco

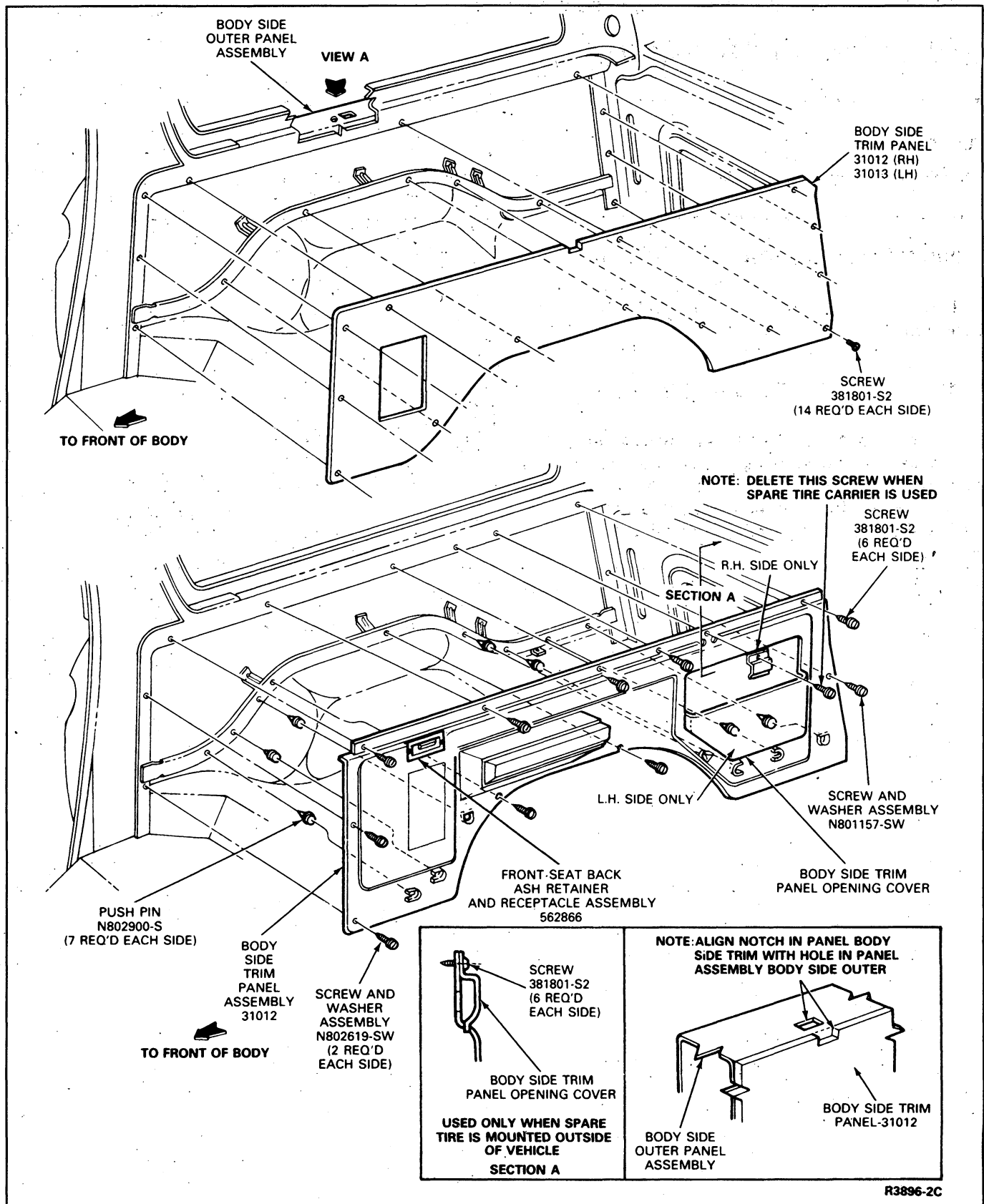


FIG. 24 Body Side Trim Panels—Bronco

## SECTION 45-16 Mouldings

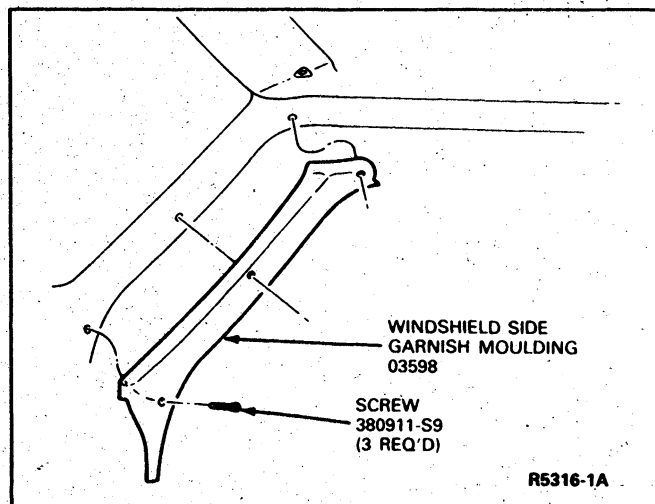
SUBJECT	PAGE	SUBJECT	PAGE
REMOVAL AND INSTALLATION .....	45-16-1	VEHICLE APPLICATION .....	45-16-1

### VEHICLE APPLICATION

All E-150 through E-350, F-150 through F-350, F-Super Duty and Bronco Models.

### REMOVAL AND INSTALLATION

The installation of the plastic and steel interior mouldings are shown in Figs. 1 through 10. In most instances, one moulding overlaps another moulding. If this condition is found, it will be necessary to loosen or remove the overlapping moulding before removal of the desired moulding.



**FIG. 1 Windshield Garnish Mouldings—E-150 through E-350**

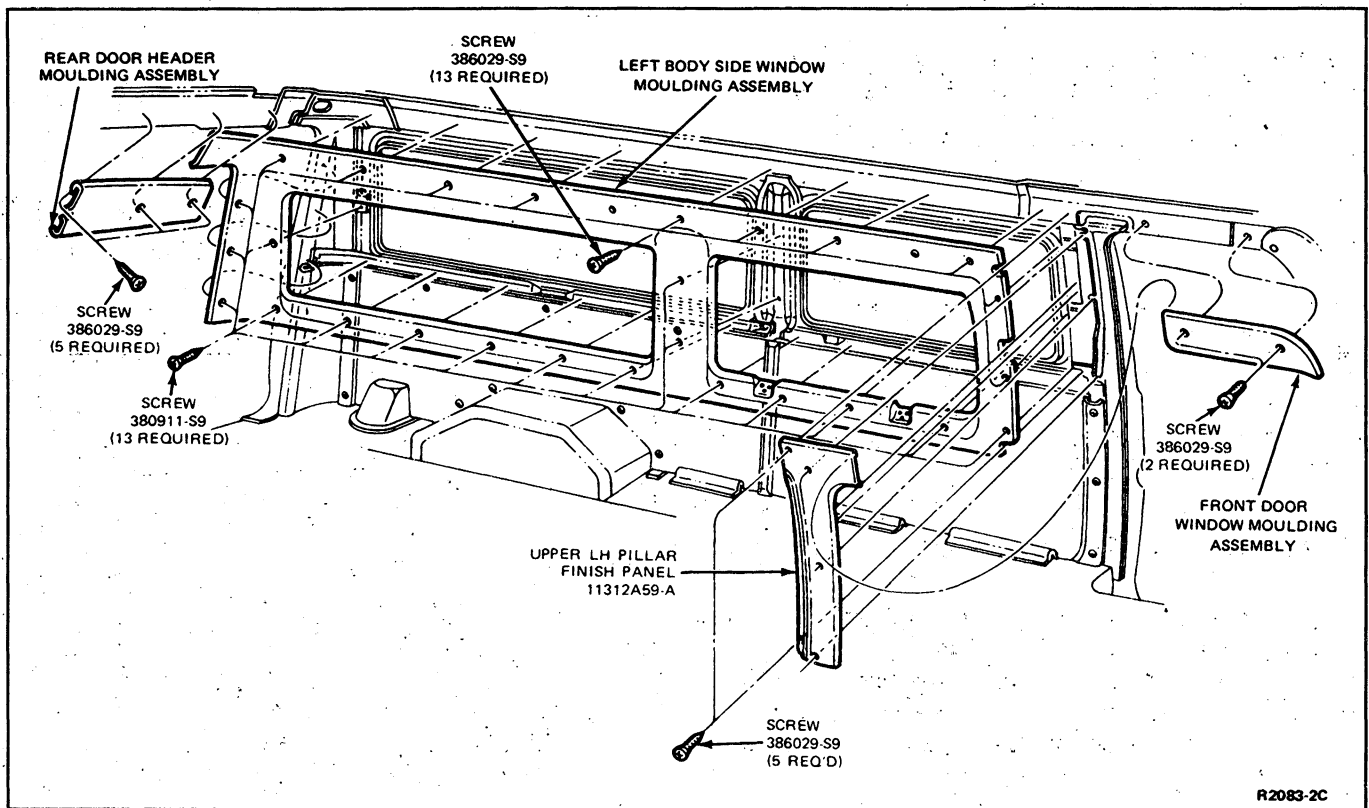
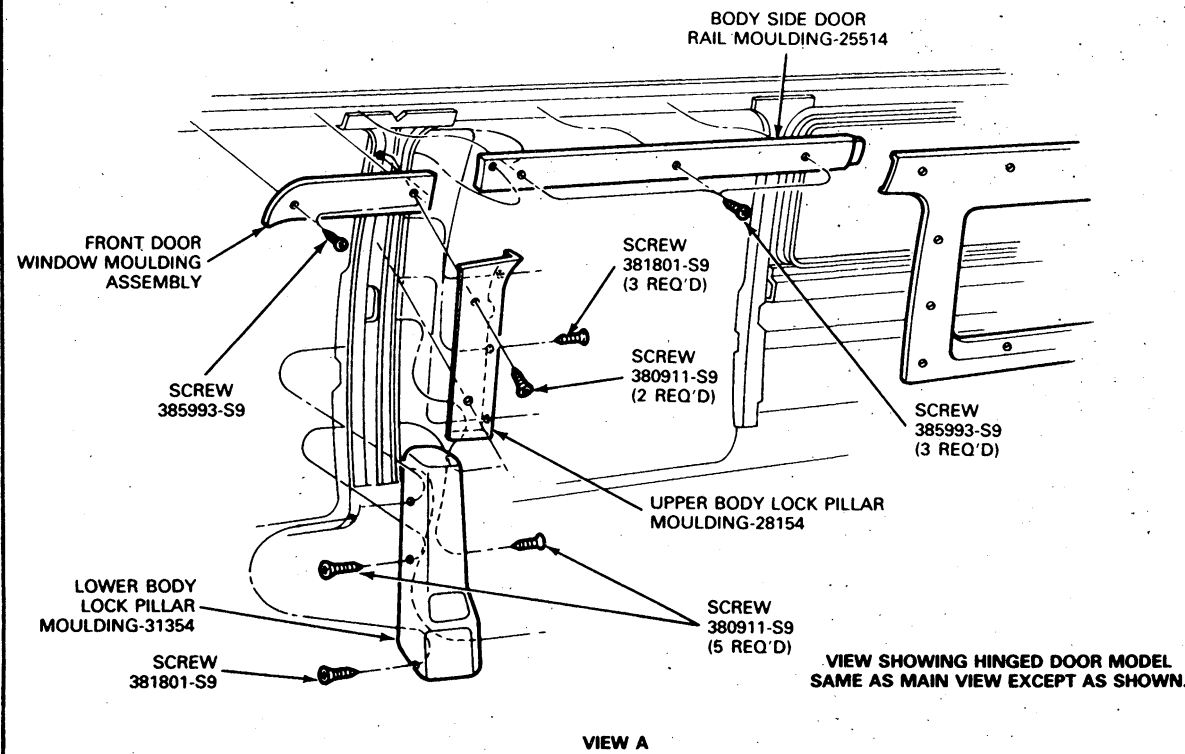
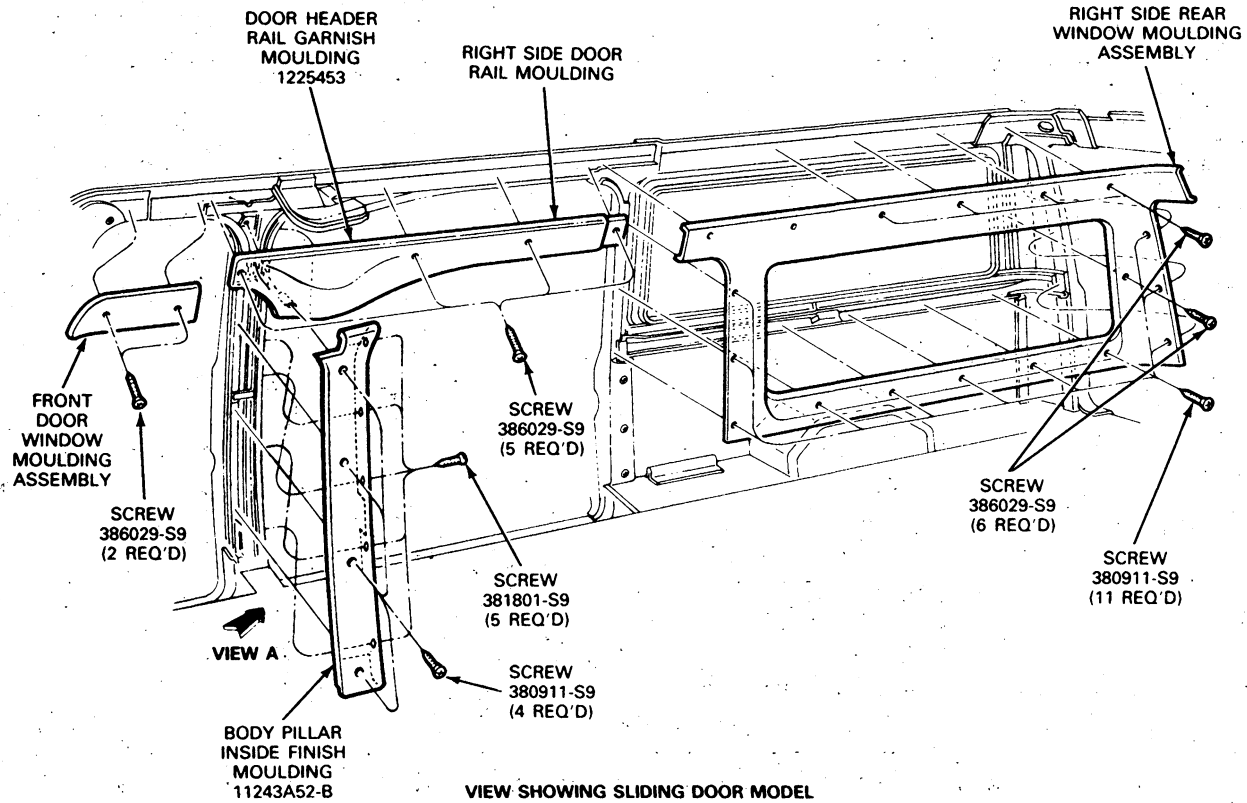


FIG. 2 Left Side Interior Mouldings—138 Inch W.B. Similar—E-150—E-350



R2084-2D

FIG. 3 Right Side Interior Mouldings—138 Inch W.B.—E-150—E-350



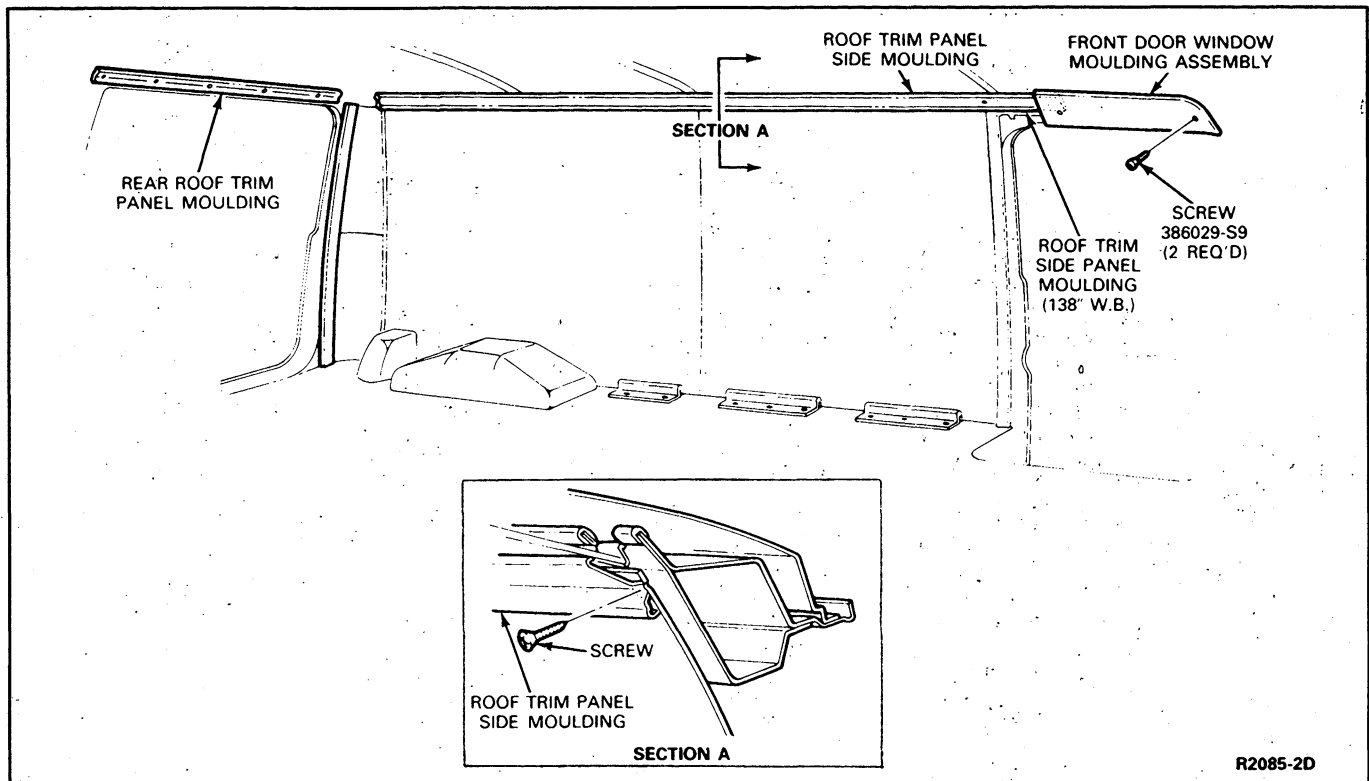


FIG. 4 Right Side Interior Mouldings—Optional 124 and 138 Inch W.B.—Left Side Similar—E-150—E-350

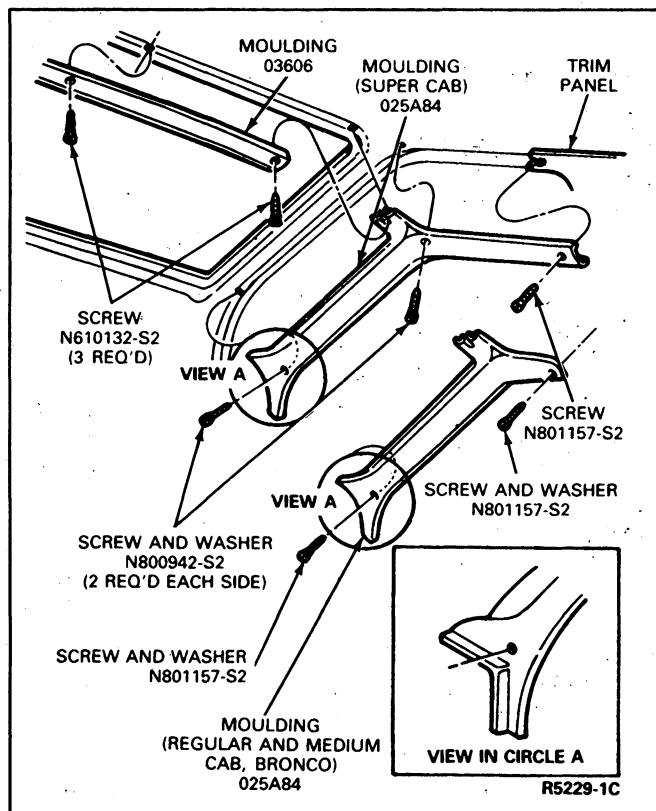


FIG. 5 Window Interior Garnish Mouldings—F-150—F-350, F-350 Crew Cab, F-Super Duty and Bronco

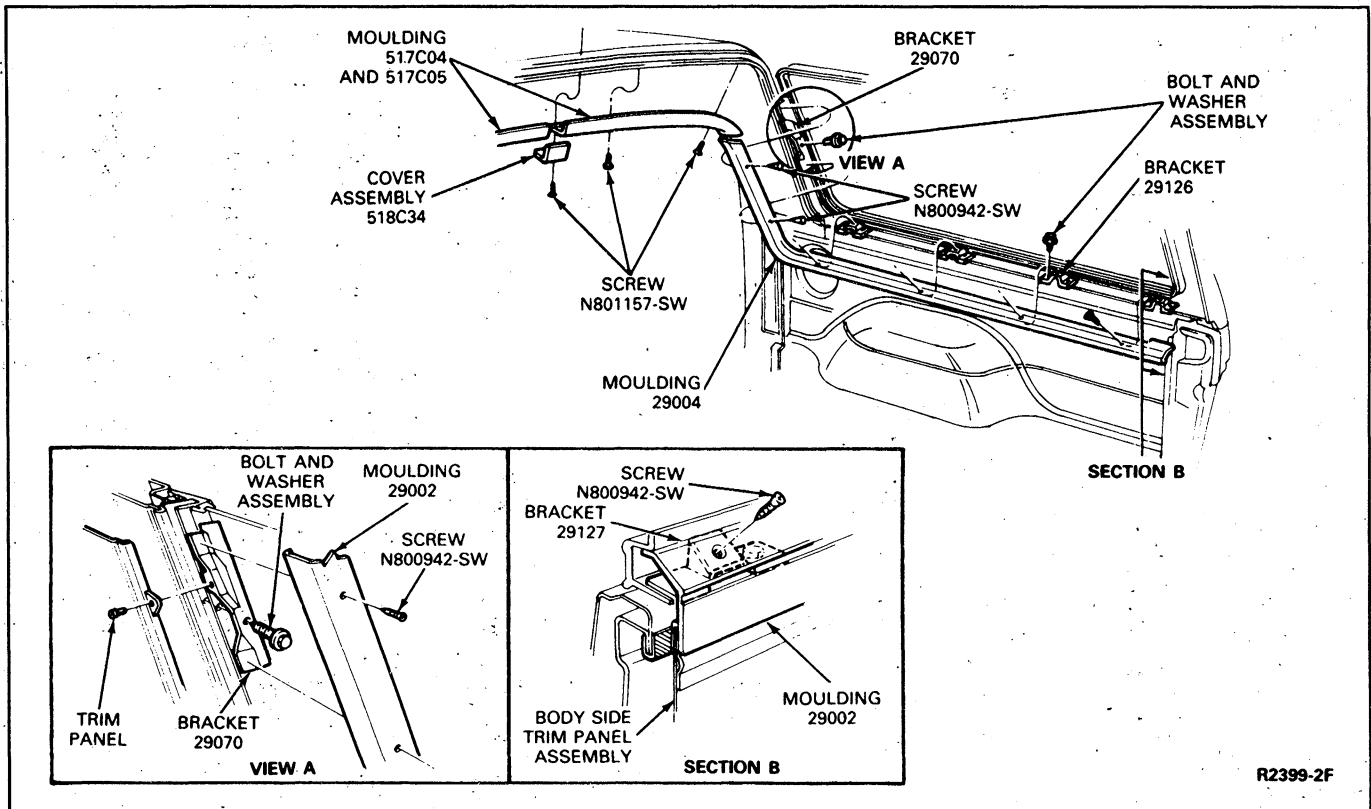


FIG. 6 Body Side and Roof Rear Garnish Mouldings—Bronco

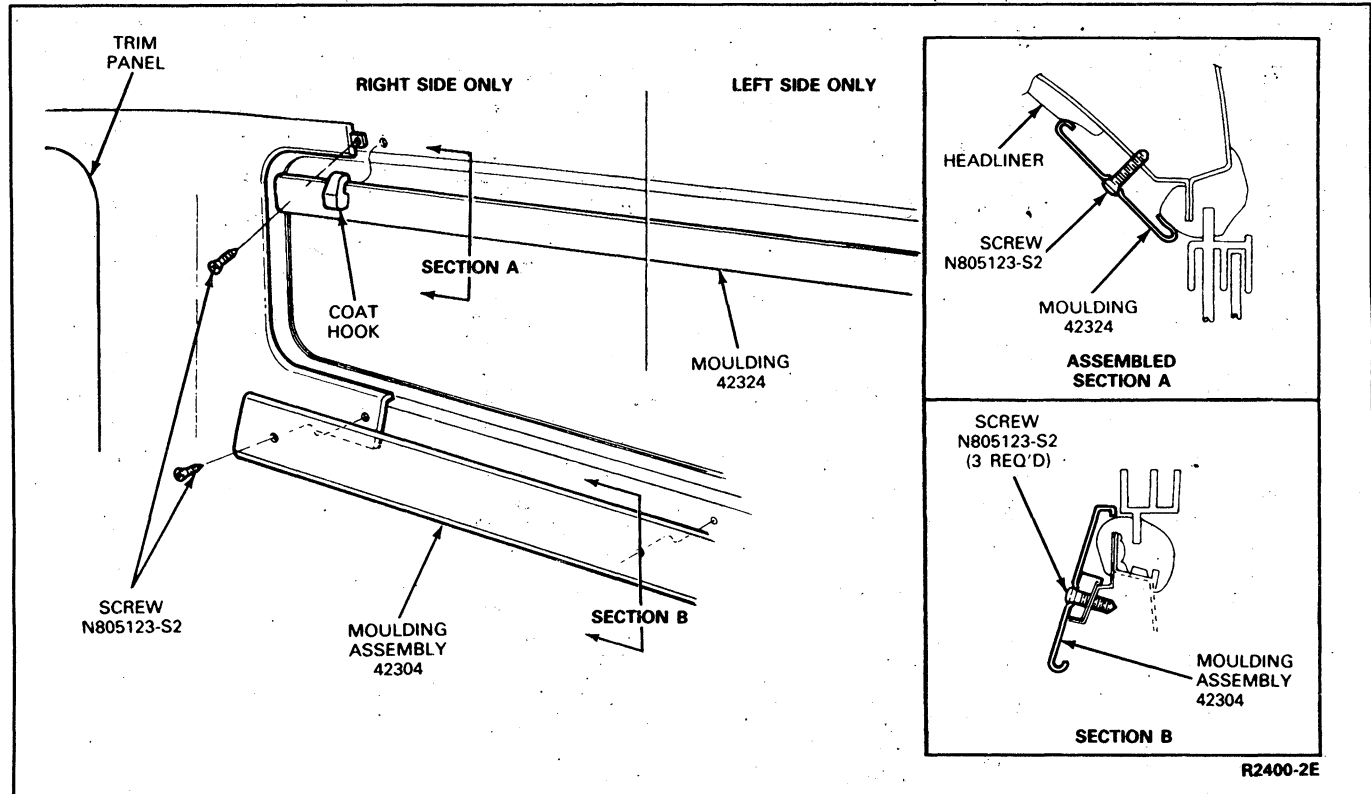


FIG. 7 Back Window Garnish Moulding—Hi Series—F-150—F-350 and F-Super Duty

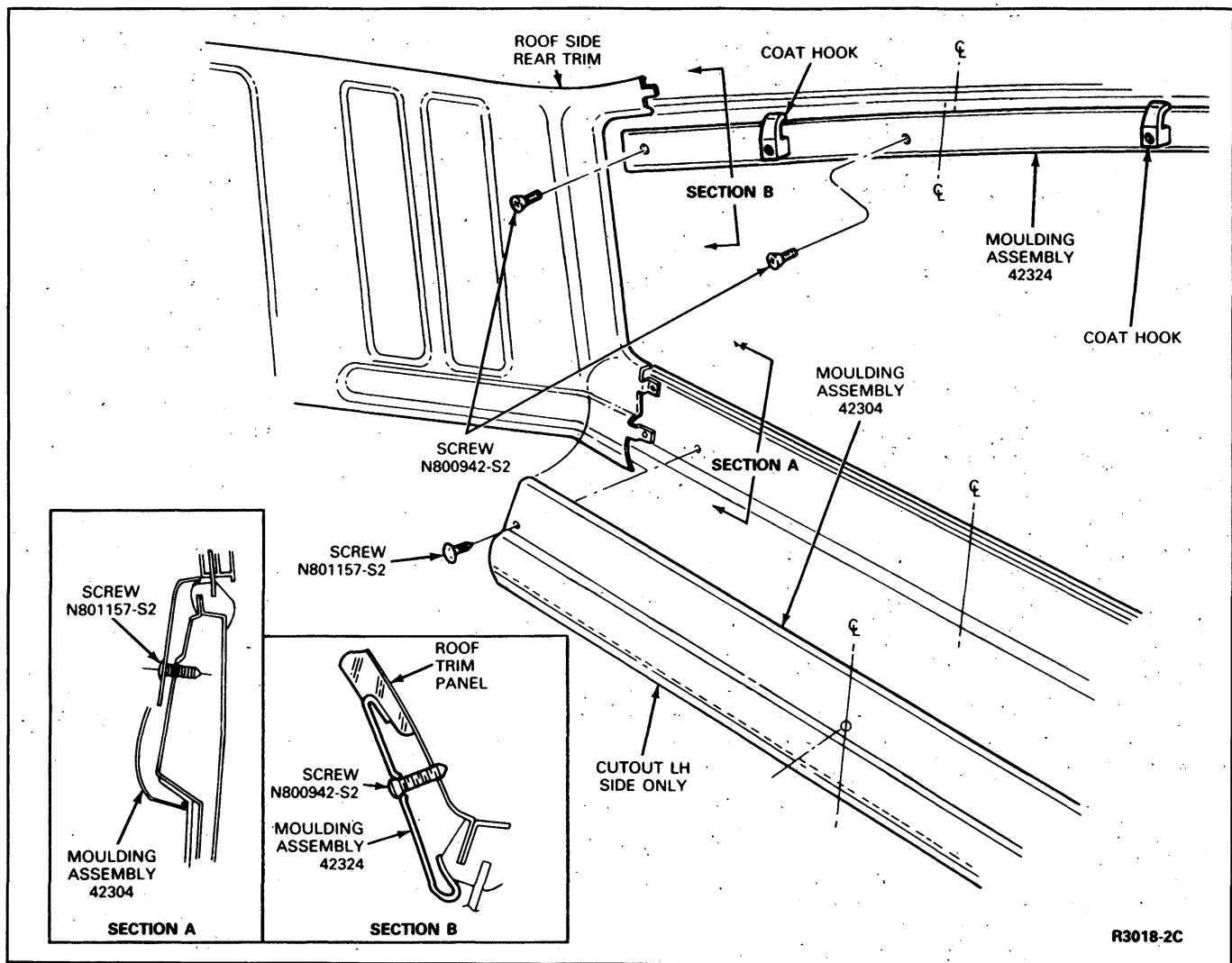


FIG. 8 Back Window Garnish Moulding—Super Cab—F-150—F-350

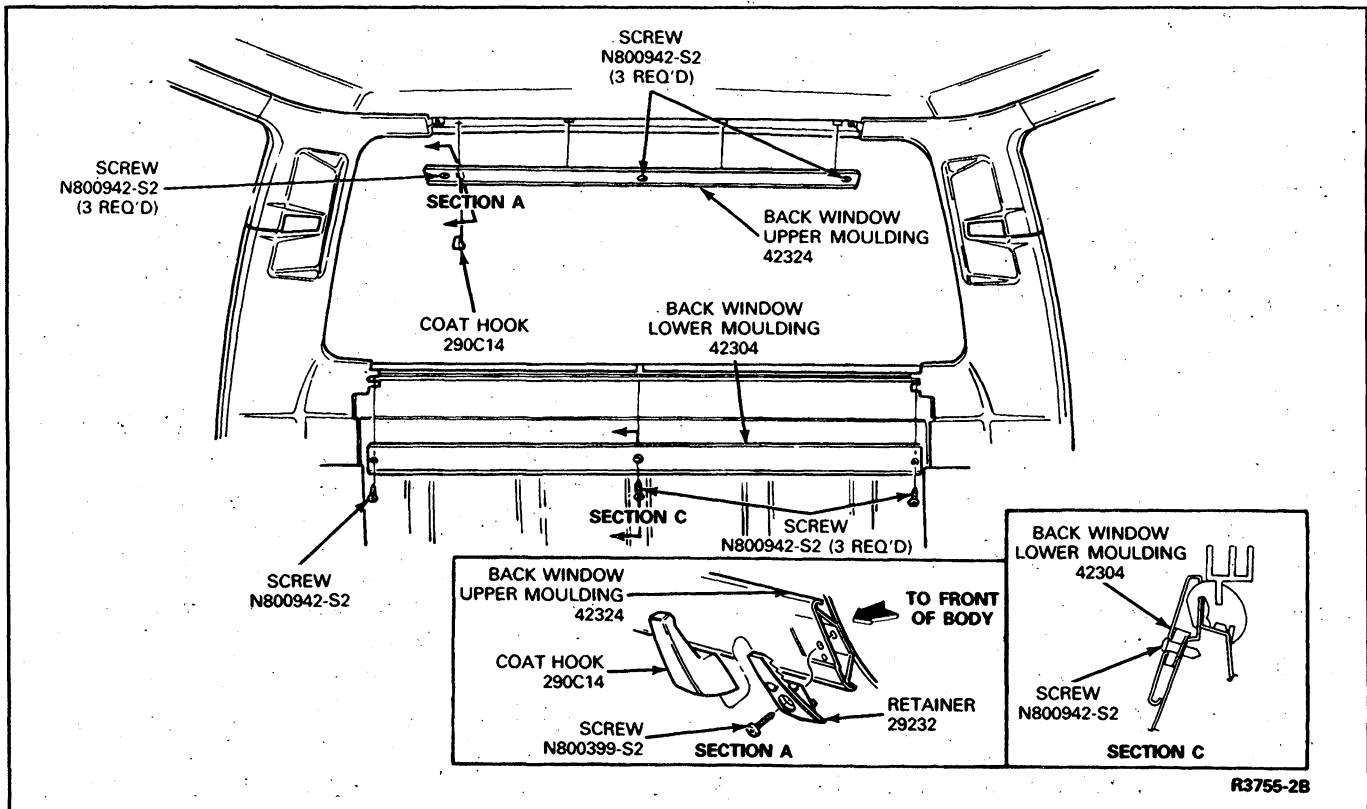


FIG. 9 Back Window Moulding and Coat Hook—F-350 Crew Cab

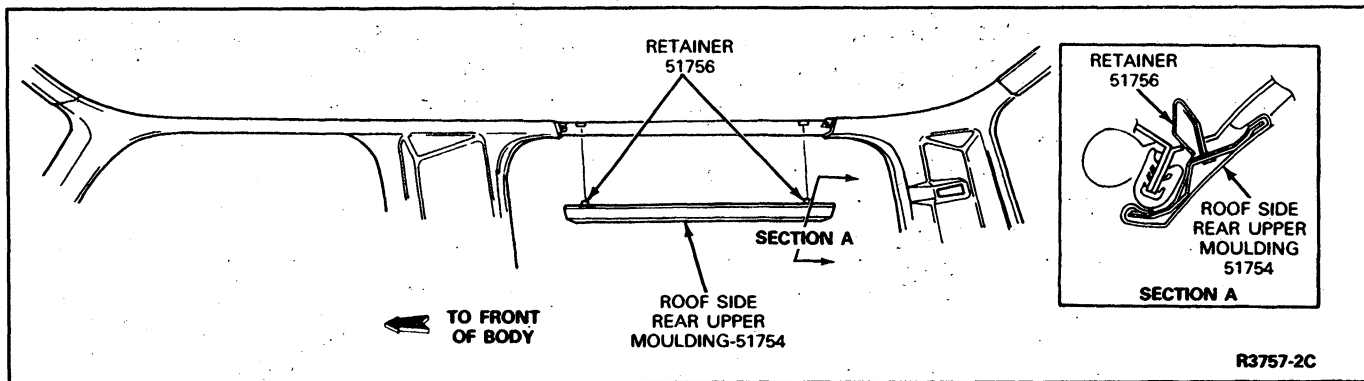


FIG. 10 Roof Side Moulding—F-350 Crew Cab

# SECTION 45-26 Carpets and Floor Mats

SUBJECT	PAGE	SUBJECT	PAGE
<b>CLEANING AND INSPECTION</b>		<b>REMOVAL AND INSTALLATION</b>	
Dirt, Dry Soil, Food, Pop and Coffee .....	45-26-3	Floor Carpet/Mat .....	45-26-1
General Stain Cleaning .....	45-26-3	<b>VEHICLE APPLICATION</b> .....	45-26-1
Spot Cleaning Stains .....	45-26-2		

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350, F-Super Duty and Bronco.

## REMOVAL AND INSTALLATION

### Floor Carpet/Mat

#### Removal

E-150—E-350, F-150—F-350, F-Super Duty and Bronco

1. Remove the seat(s). Refer to Section 41-01, Front Seats.
2. Grasp the carpet or mat surrounding edge beneath the convoluted floor shifter boot and pull it outward and upward away from the boot (Fig. 1).
3. Remove the floor console. Refer to Section 45-31, Console Assembly.

4. Remove the screws retaining the RH and LH cowl side trim panels (Fig. 2).
5. Remove all carpet or mat retaining screws (Figs. 3 through 7).
6. Remove the screws retaining the RH and LH door sill scuff plates and remove the scuff plates (Figs. 8 and 9). Remove cowl side trim panels.
7. Remove the carpet or mat.

#### Installation

1. Using the old carpet as a template, cut the hole for the shifter, if required.
2. Position carpet or mat to vehicle (Figs. 3 through 7).
3. Position cowl side trim panels (RH and LH) and install screws to secure (Fig. 2).
4. Position RH and LH door sill scuff plates to vehicle. Install screws to secure (Figs. 8 and 9).
5. Install all carpet or mat retaining screws.

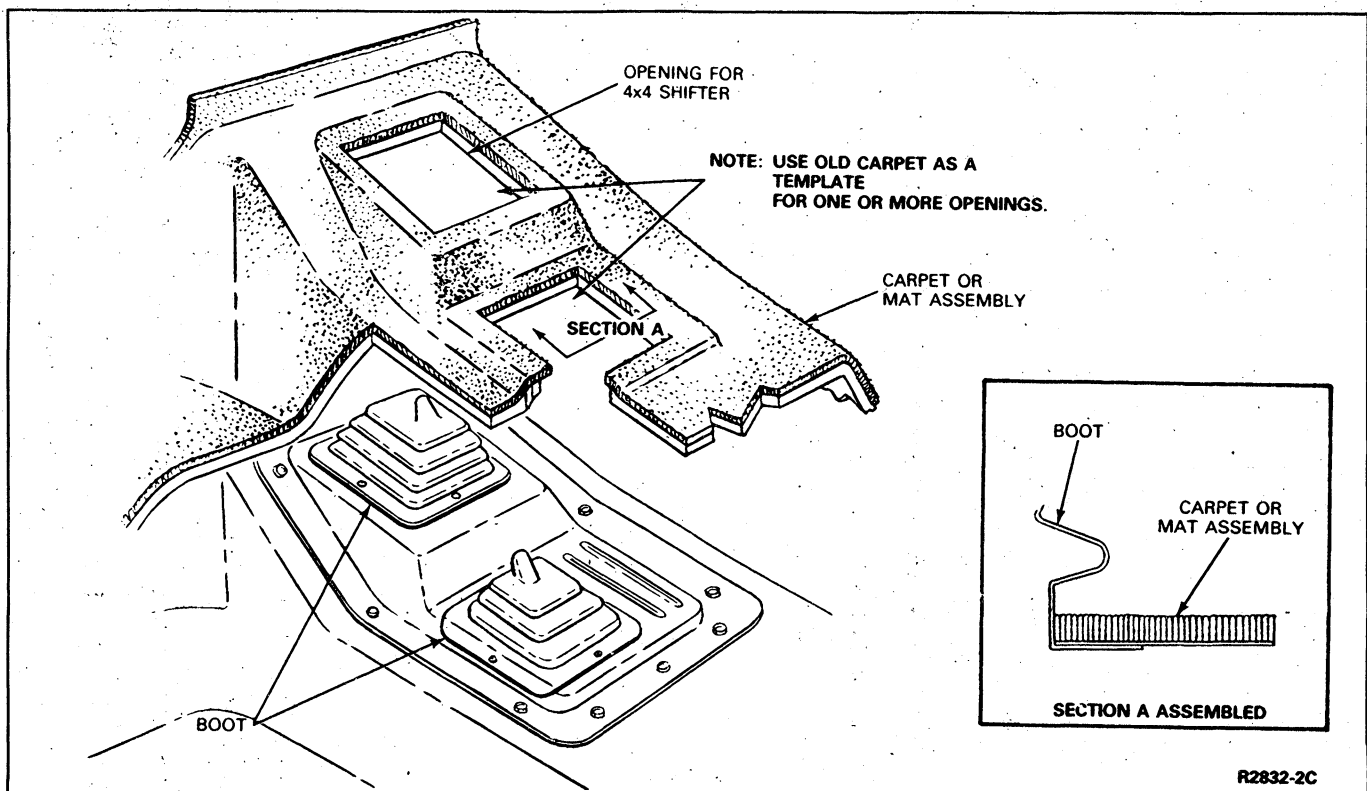


FIG. 1 Floor Carpet Center Retainers—F-150—F-350, F-Super Duty and Bronco

6. Install the console. Refer to Section 45-31, Console Assembly.
7. Install carpet or mat under floor shifter boot (Fig. 1, View A).
8. Install the seats. Refer to Section 41-01, Front Seats.

### Floor Carpet/Mat

#### Removal and Installation

##### E-150—E-350

1. Remove the seat(s). Refer to Section 41-01, Front Seats.
2. Remove the floor shifter carpet-retainer (Fig. 10).
3. Repeat E-150—E-350, F-150—F-350 and Bronco Removal Steps 4 through 7 (Figs. 11 through 19).
4. To install, reverse Steps 1, 2 and 3.

### CLEANING AND INSPECTION

The following procedure is recommended for the removal of spots and stains encountered in service. It is important that proper cleaning techniques and cleaning agents be used to prevent the stain setting of affecting the color and/or flame resistant properties of the fabric.

1. Remove excess staining material from fabric by scraping or wiping with a clean cloth.
2. Identify the staining material if possible.
3. Clean the fabric as outlined in the following Steps.

#### Spot Cleaning Stains

##### Grease, Oil, Tar, Water Spots, Crayon and Lipstick

1. Spray stain with Spot Lifter C9AZ-19526-A or equivalent from a distance of 204-254 N·m (8-10 inches) as directed per the instructions furnished with the can.
2. Allow the Spot Lifter to dry completely forming a white powder on the surface of the fabric.

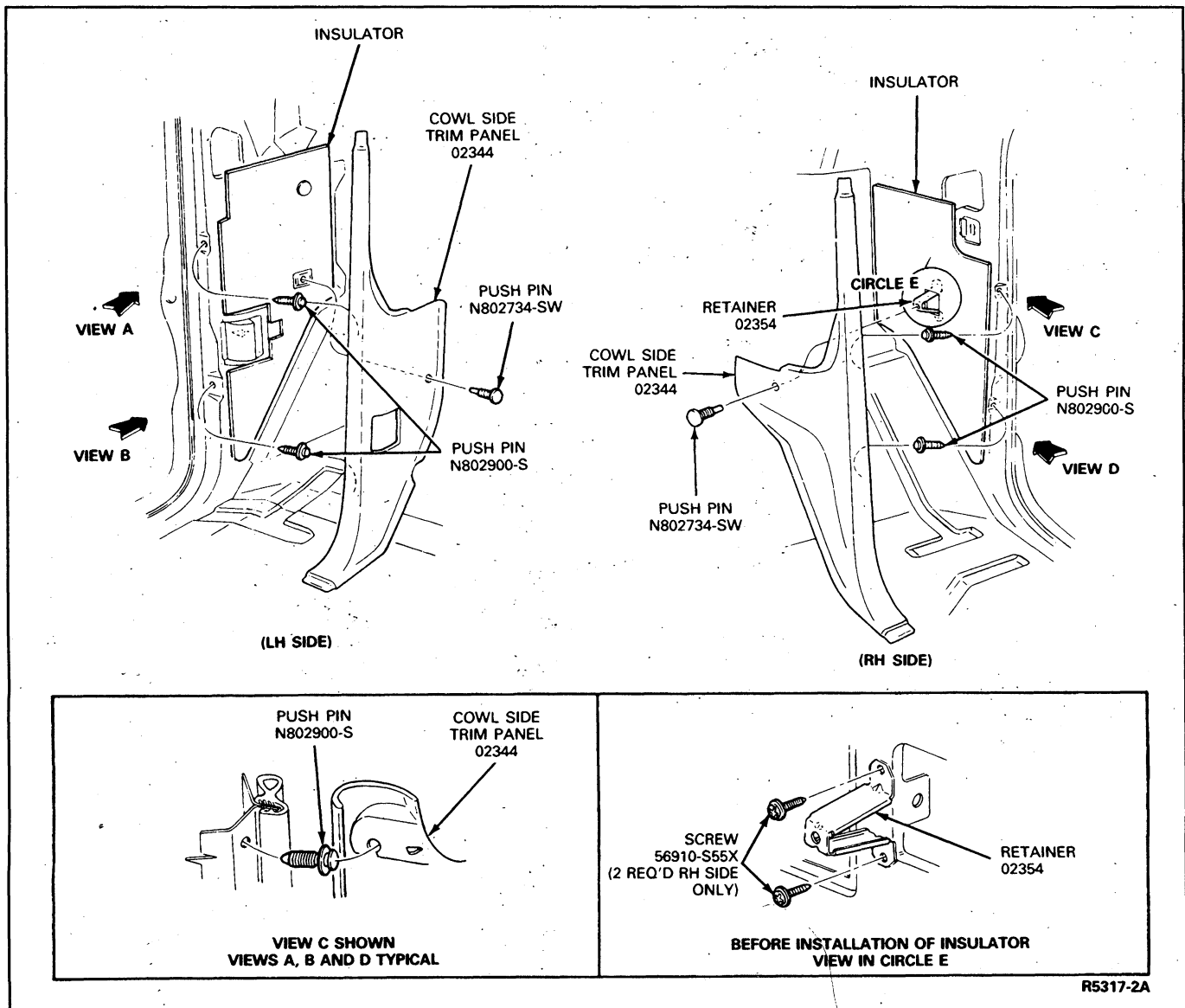


FIG. 2 Cowl Side Trim Panels—F-150—F-350, F-Super Duty and Bronco

3. Brush and vacuum the white powder from the surface of the fabric.
4. If the soiled spot is not removed from the fabric, repeat Steps 1, 2 and 3 as necessary.

### General Stain Cleaning

#### Grease, Oil, Tar, Adhesive, Crayon and Lipstick

1. If the stain is still visible after the spot cleaning procedure, blot the soiled area with a clean cotton cloth saturated with the Extra Strength Spot and Stain Remover (Part No. B7A-19521-AA) or equivalent.
2. Rub in a circular motion while continuously exposing clean portion of cloth.
3. Gradually widen area of application onto edges of design, pleat, or biscuit.
4. Repeat Steps No. 1, 2 and 3 as necessary.
5. Wipe cleaned area with clean damp cloth to remove any residual cleaner.

### Dirt, Dry Soil, Food, Pop and Coffee

1. Apply Rosenthal's 8 to 1 Shampoo, or Bissell's Upholstery Shampoo for Home and Auto, or an equivalent with a clean brush or sponge as directed on the instructions furnished with the container.
2. Rub in a circular manner until stain is removed.
3. Gradually widen area of application to edges of design, pleat, or biscuit.
4. Repeat Steps 1, 2 and 3 as necessary.
5. Rub cleaned area with a damp cloth to absorb residual cleaner.
6. Allow to dry at room temperature.

NOTE: Spot cleaning as described under Spot Cleaning Stains above will be sufficient on fabrics which are not excessively soiled. However, to maintain a uniform appearance of the seat material in the event of severe soil and stain, the entire seat or insert will have to be cleaned to prevent a "ring" condition.

It is advisable to clean all fabric material immediately upon detection of soilage.

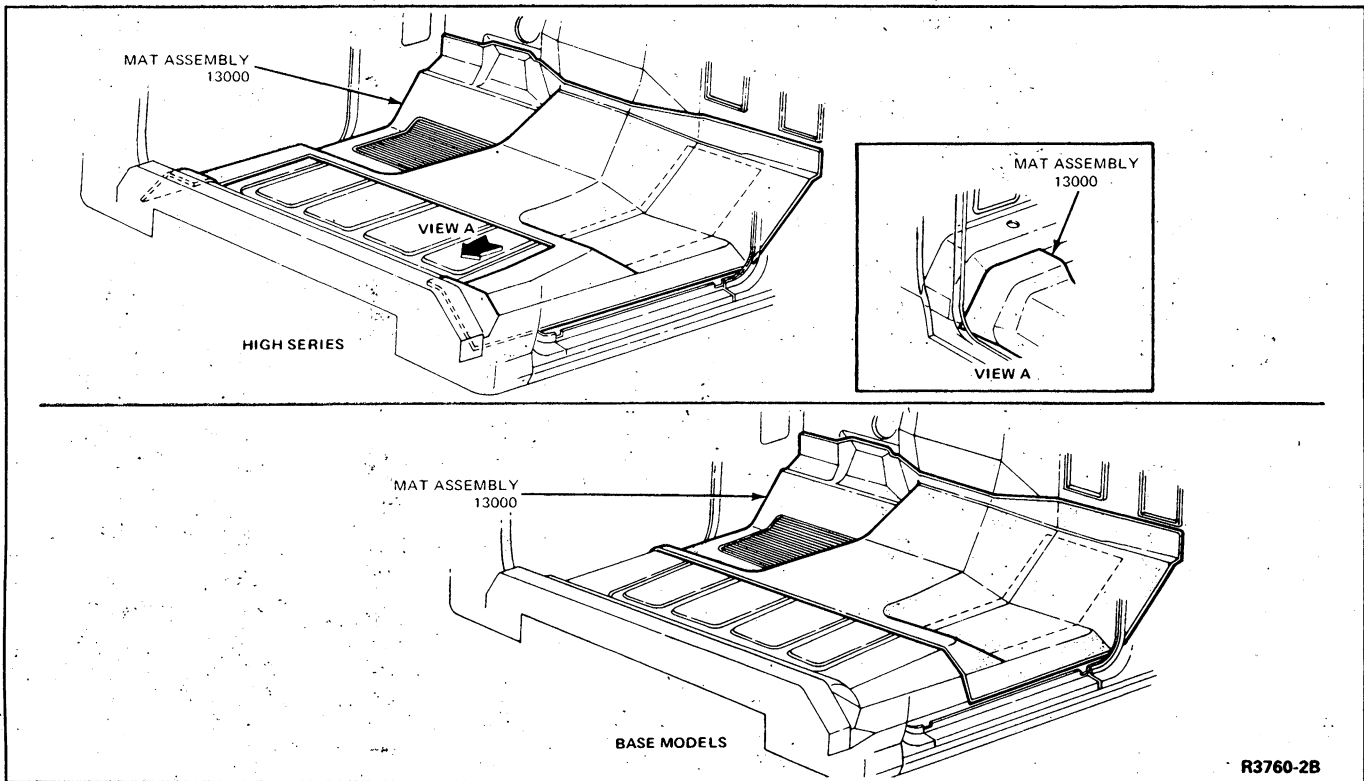


FIG. 3 Floor Mats—F-150—F-350 Regular Cab

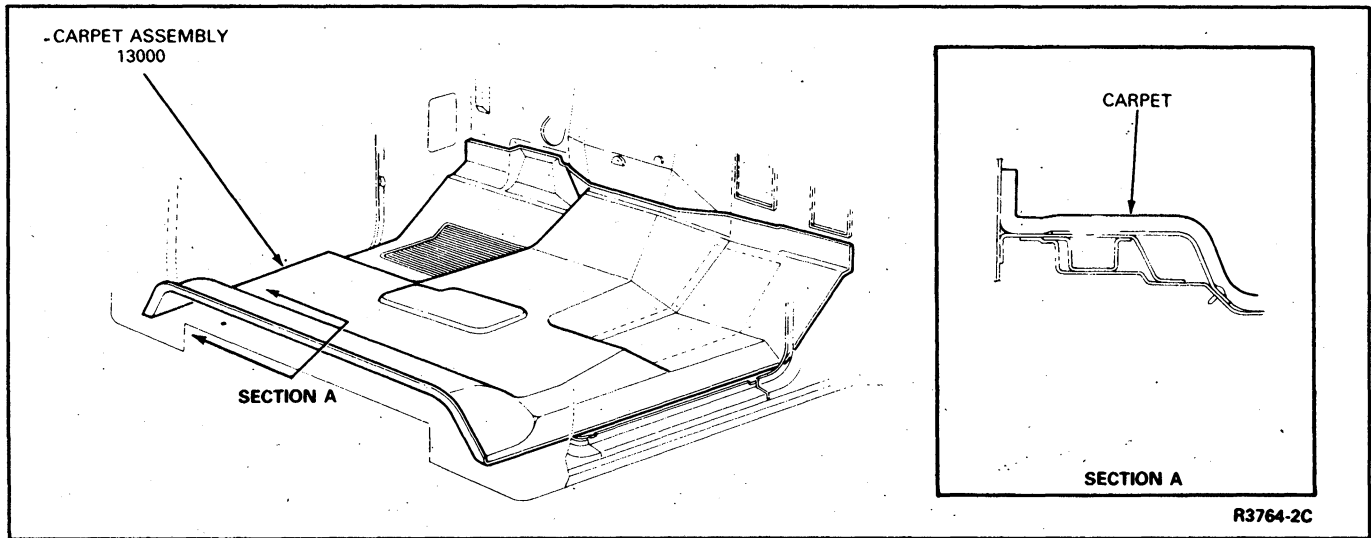


FIG. 4 Floor Carpet—F-150—F-350 Regular Cab



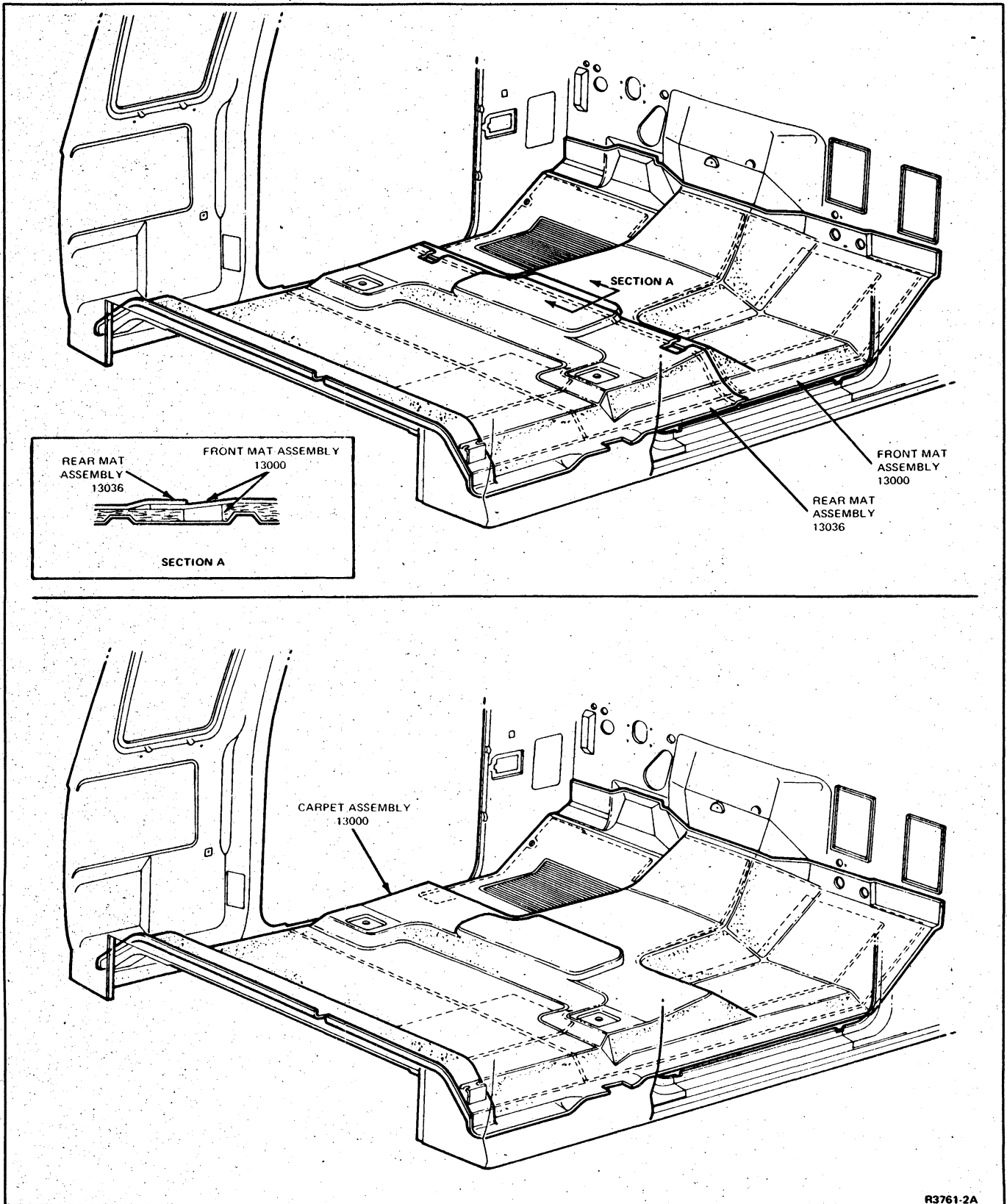


FIG. 5 Floor Mat and Carpet—F-Series Super Cab

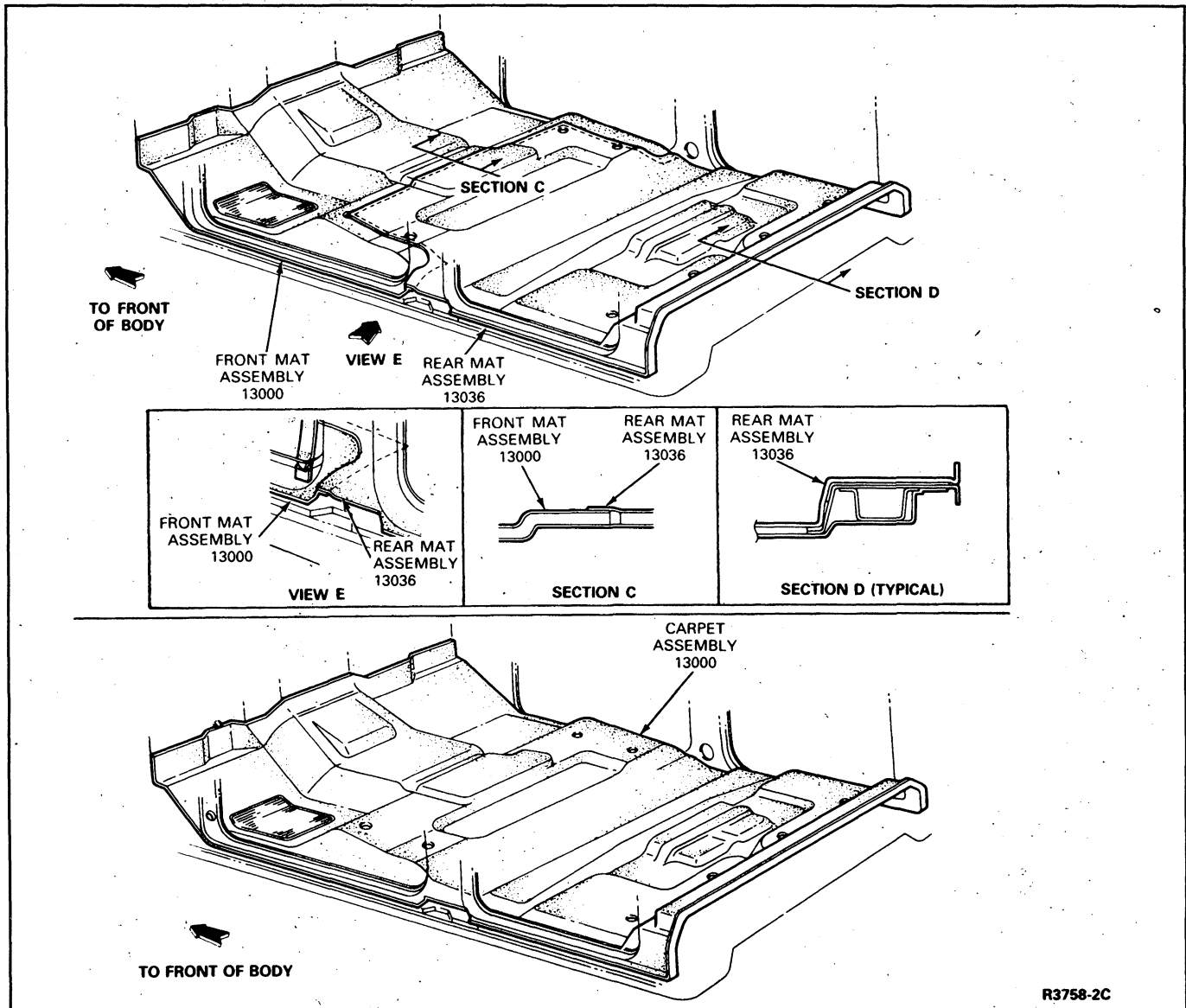


FIG. 6 Floor Mat and Carpet—F-350 Crew Cab

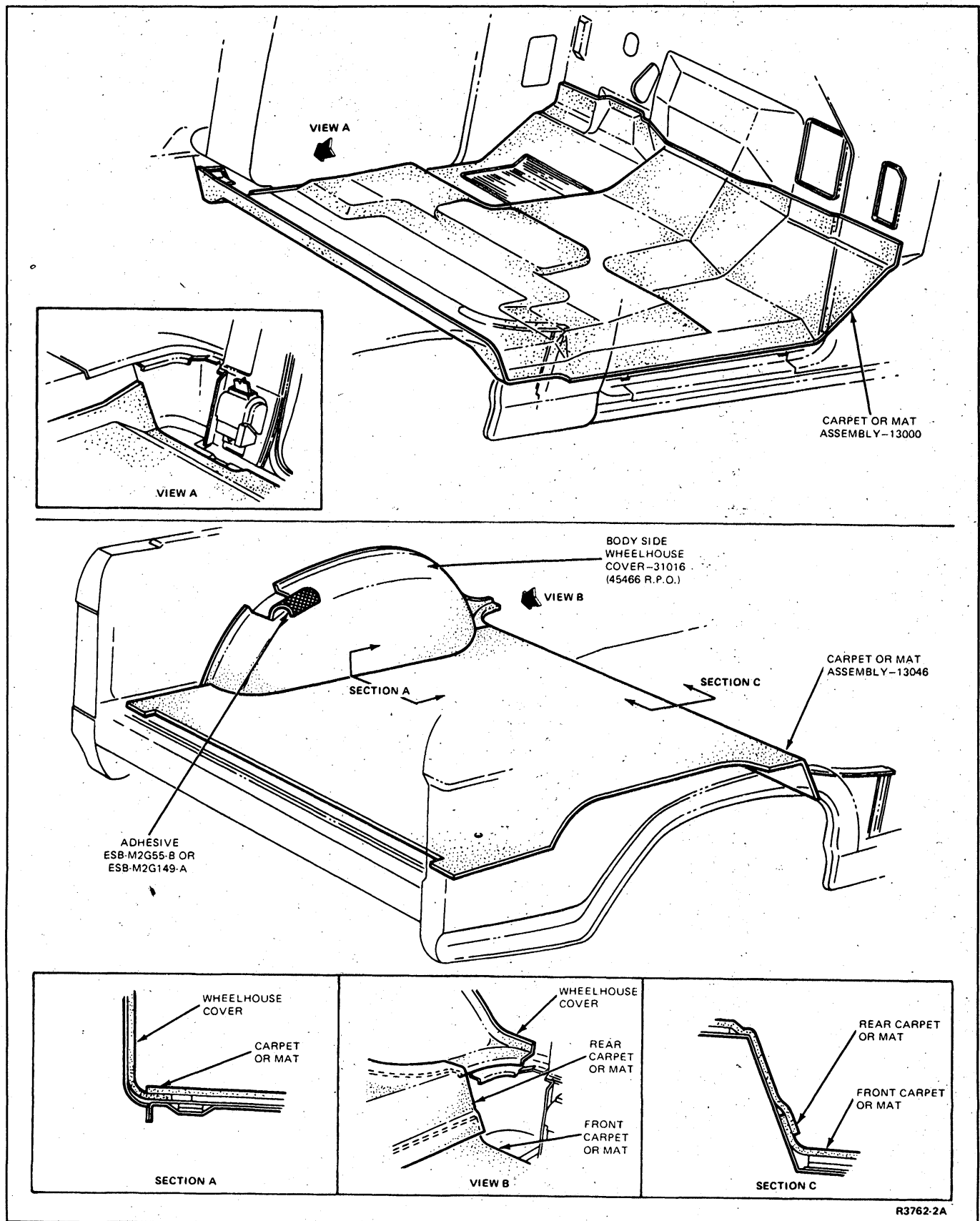


FIG. 7 Floor Mat and Carpet—Bronco

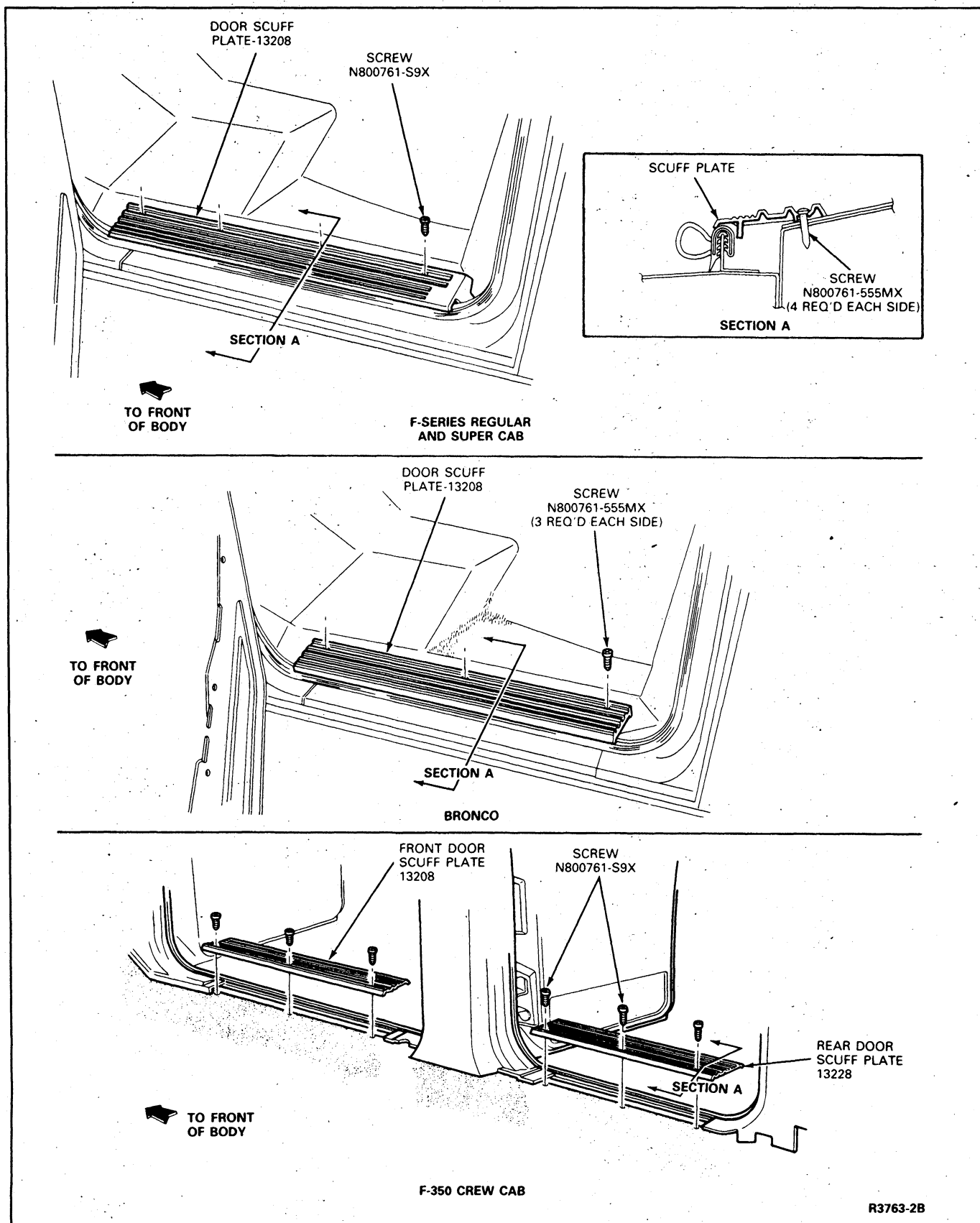


FIG. 8 Door Scuff Plates—F-150—F-350 and Bronco

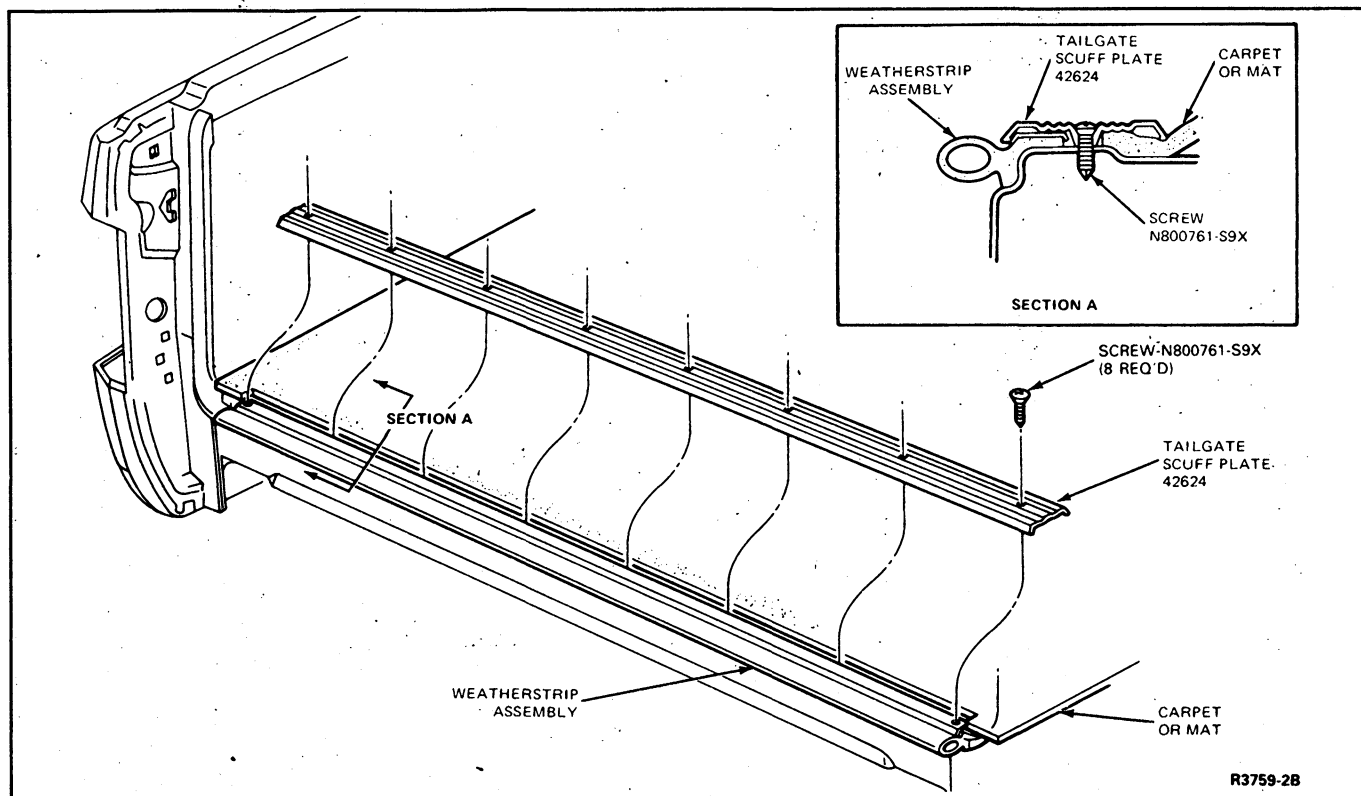


FIG. 9 Tailgate Scuff Plate—Bronco

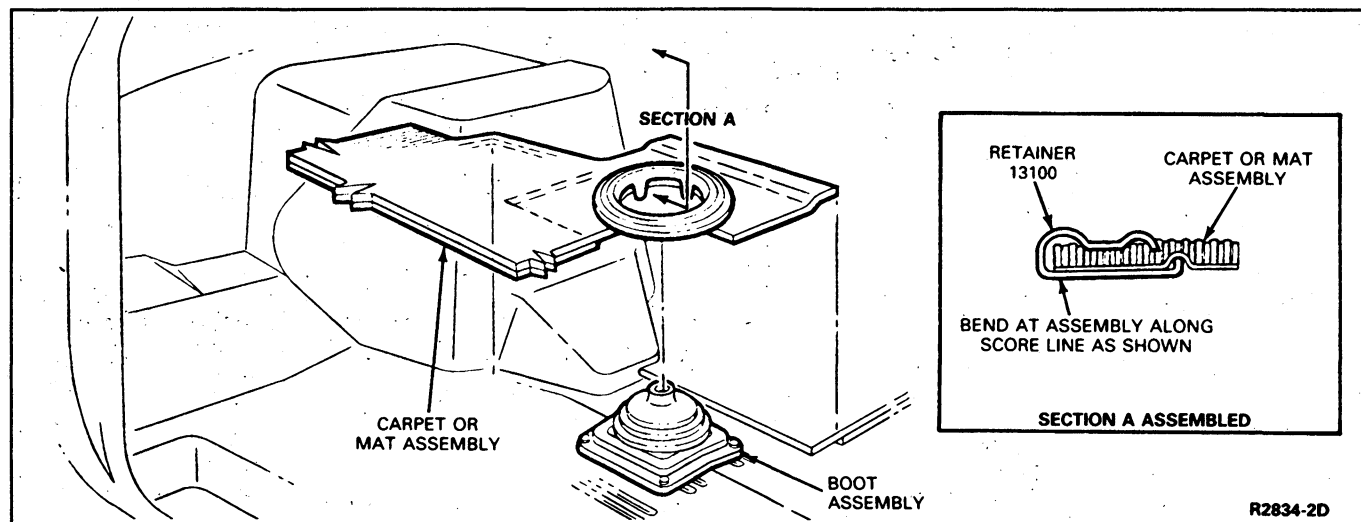


FIG. 10 Floor Carpet Center Retainers—E-150—E-350

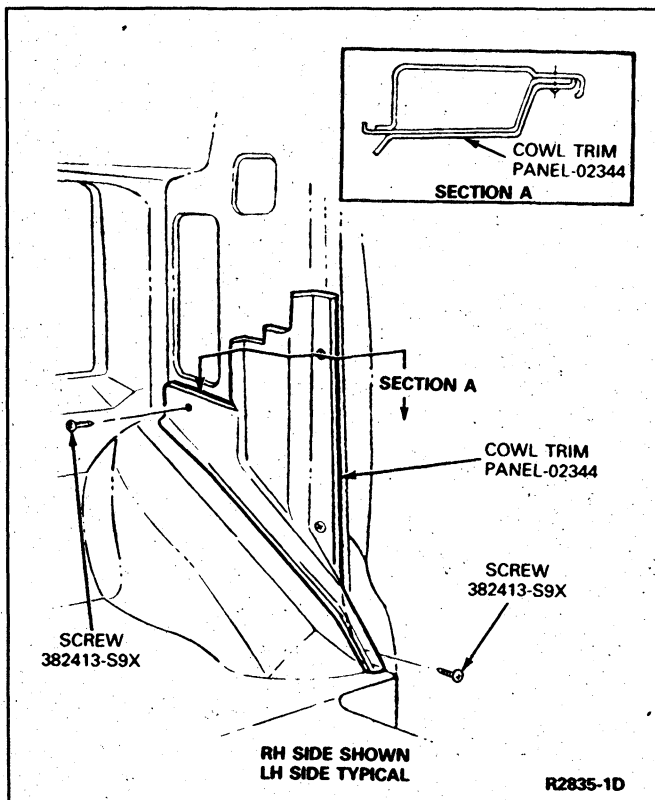


FIG. 11 Cowl Side Trim Panels—E-150—E-350

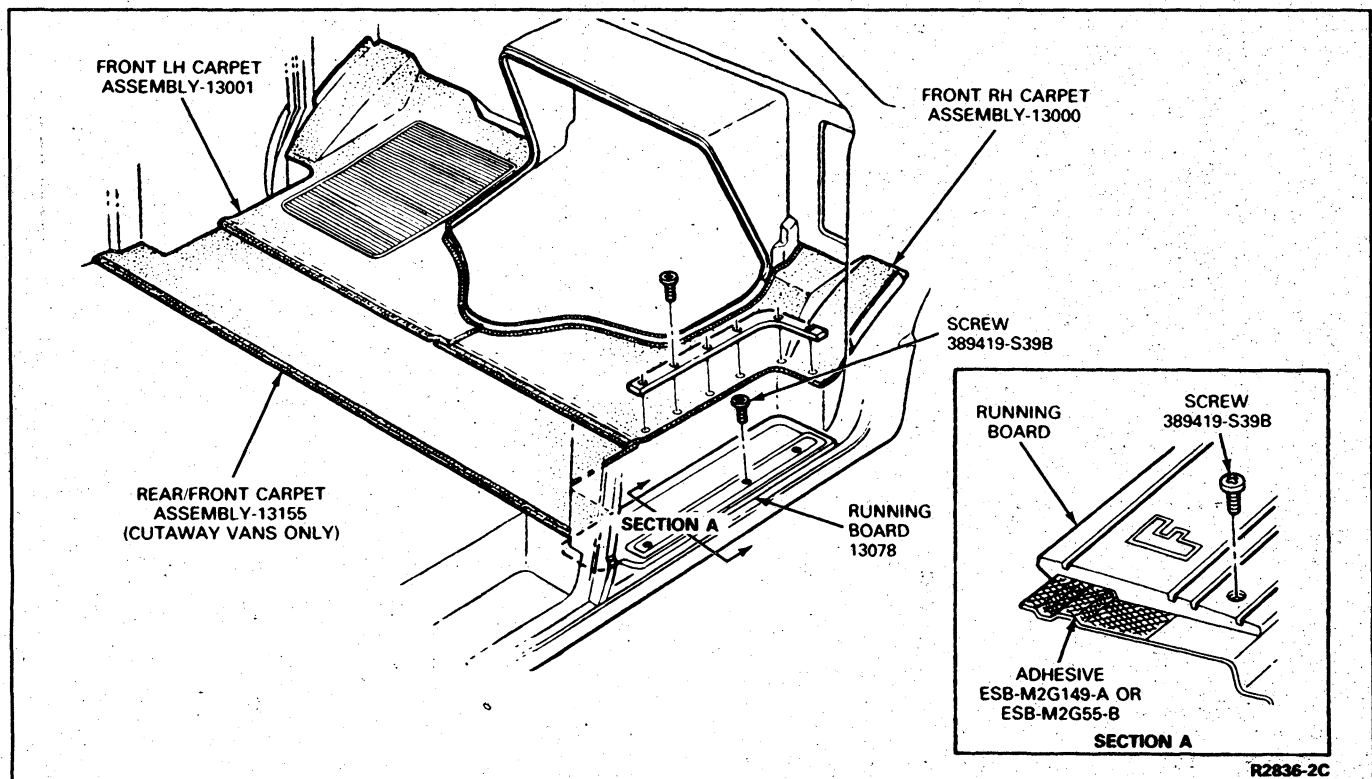


FIG. 12 Front Floor Carpets—E-150—E-350

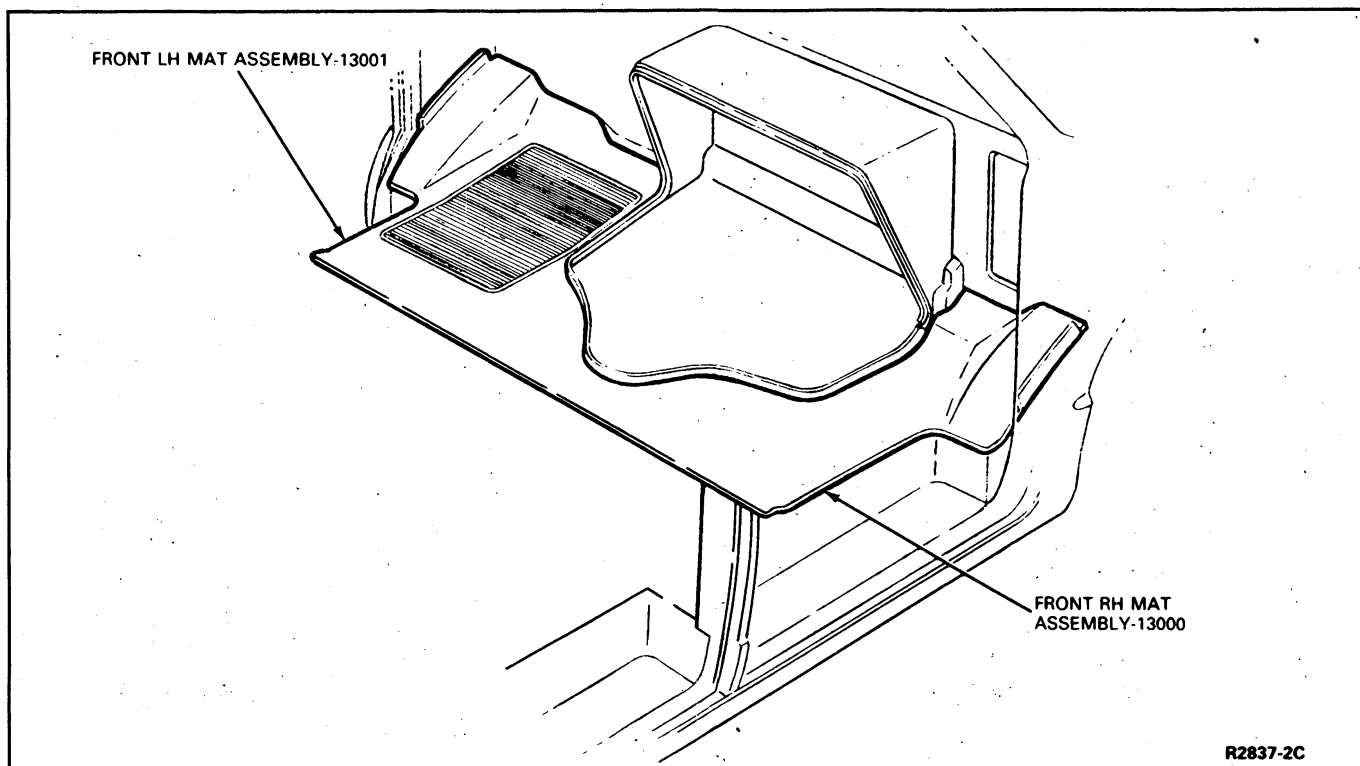


FIG. 13 Front Floor Mats—E-150—E-350

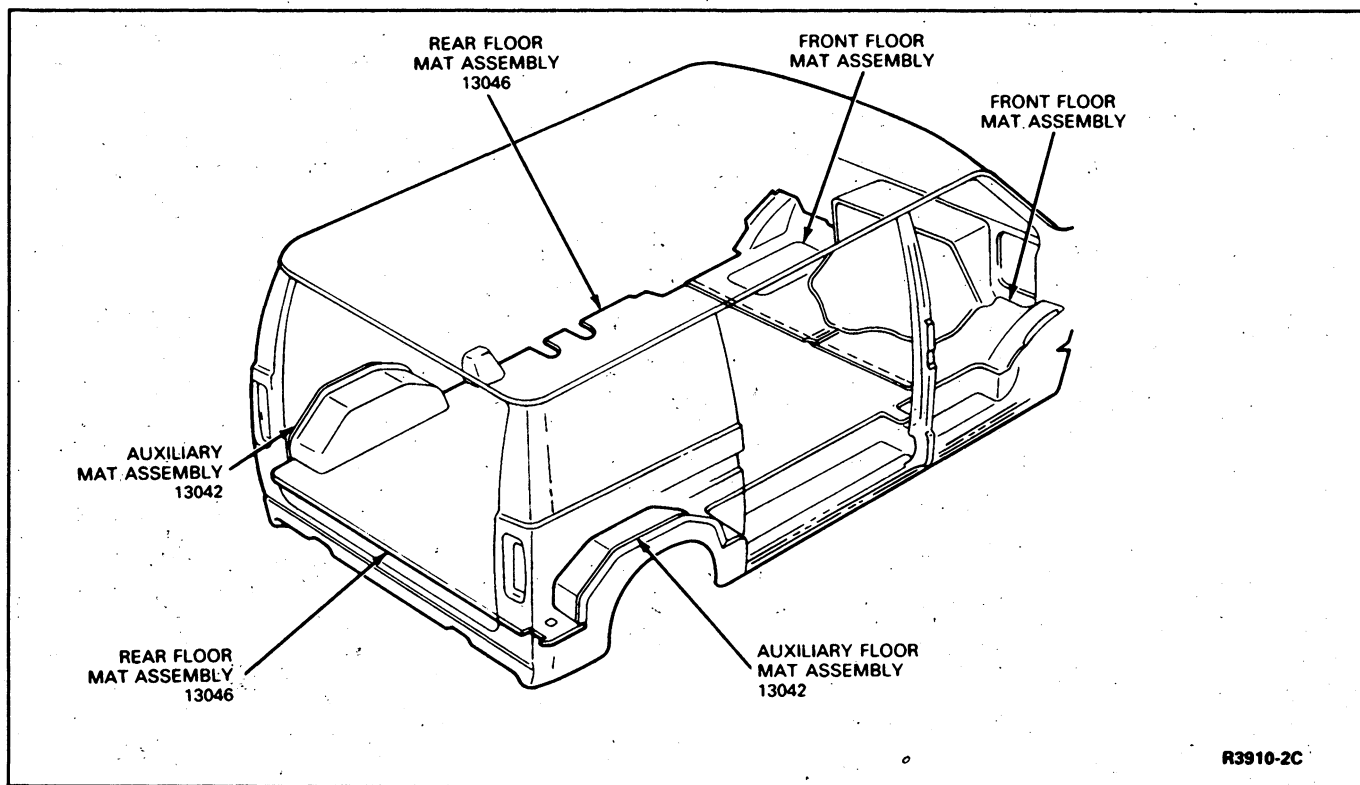


FIG. 14 Rear Floor Mats—E-150—E-350—Vans Only—124-Inch W.B.

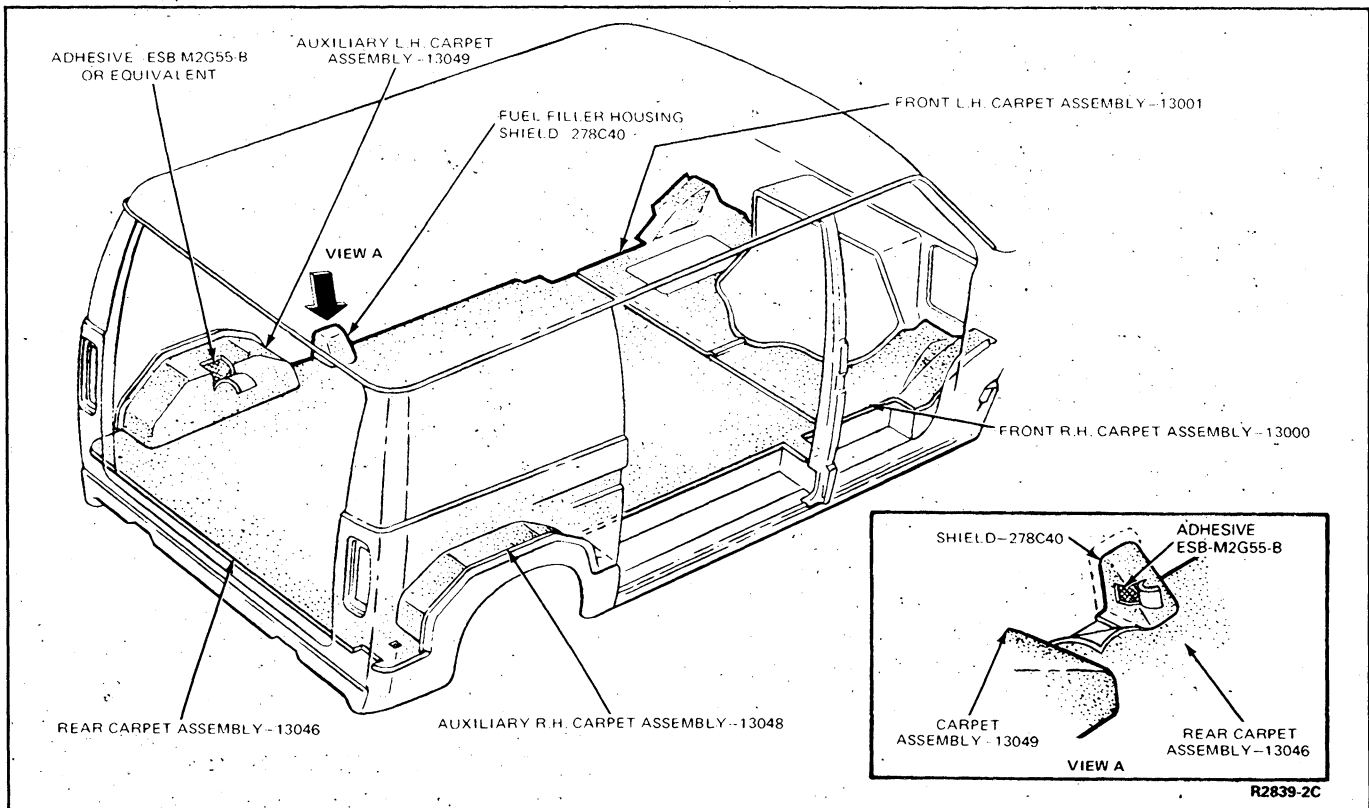


FIG. 15 Rear Floor Carpets—E-150—E-350—124-Inch W.B.

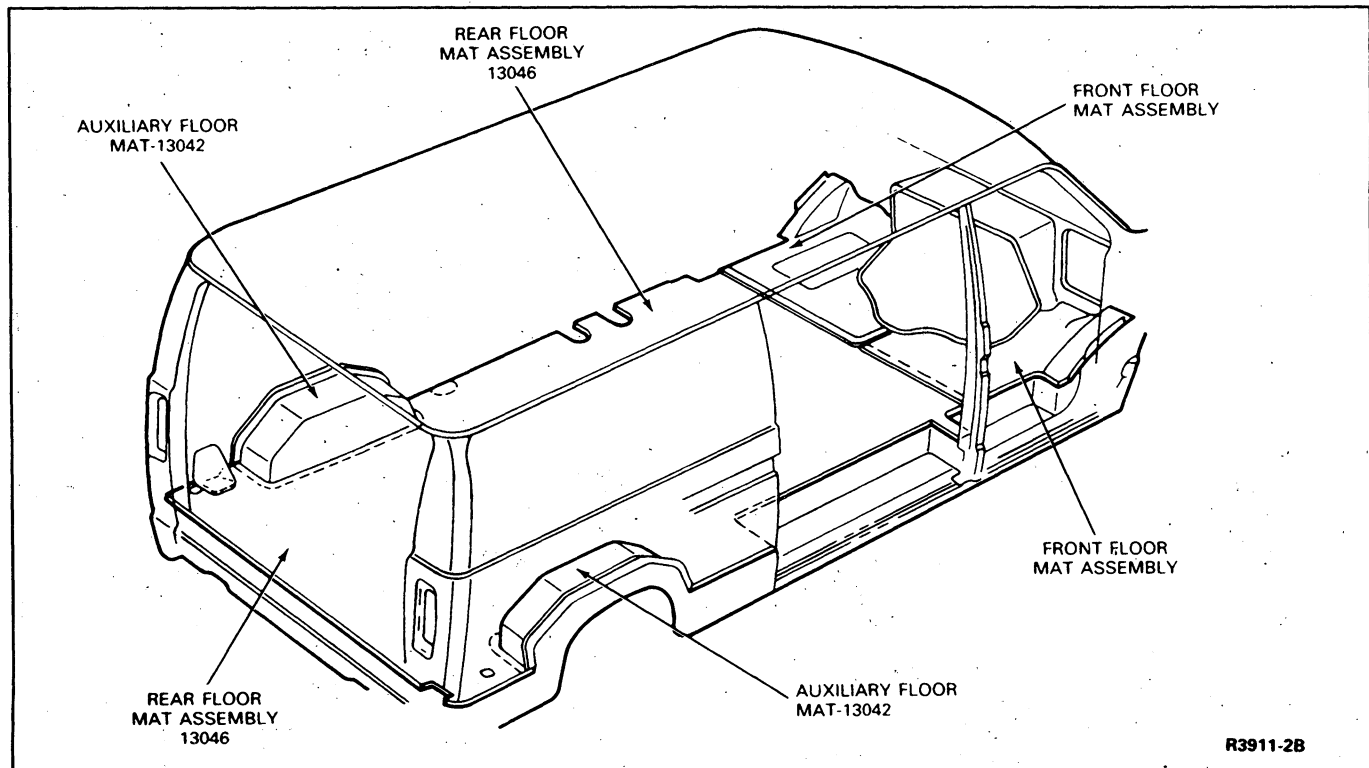


FIG. 16 Rear Floor Mats—E-150—E-350—Vans Only—138-Inch W.B.



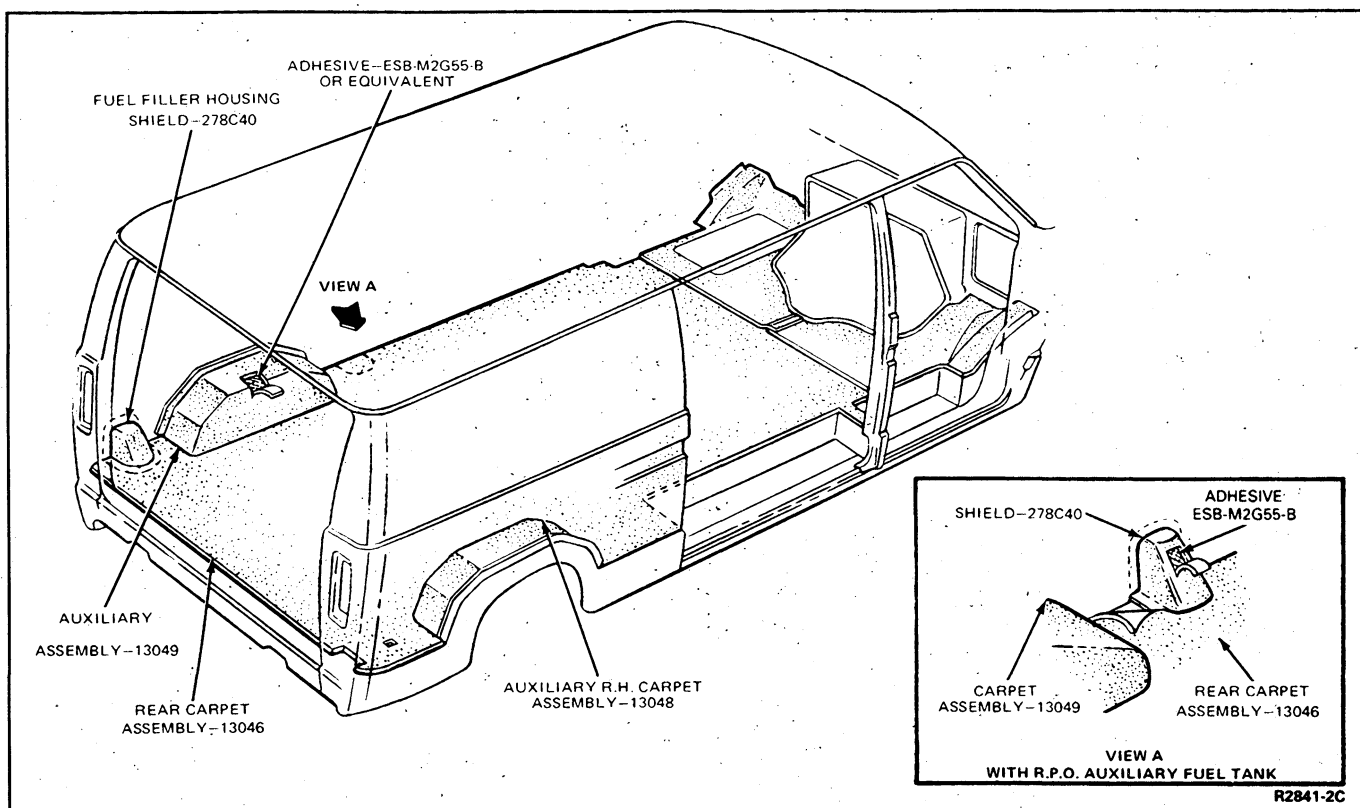


FIG. 17 Rear Floor Carpets—E-150—E-350—138-Inch W.B.

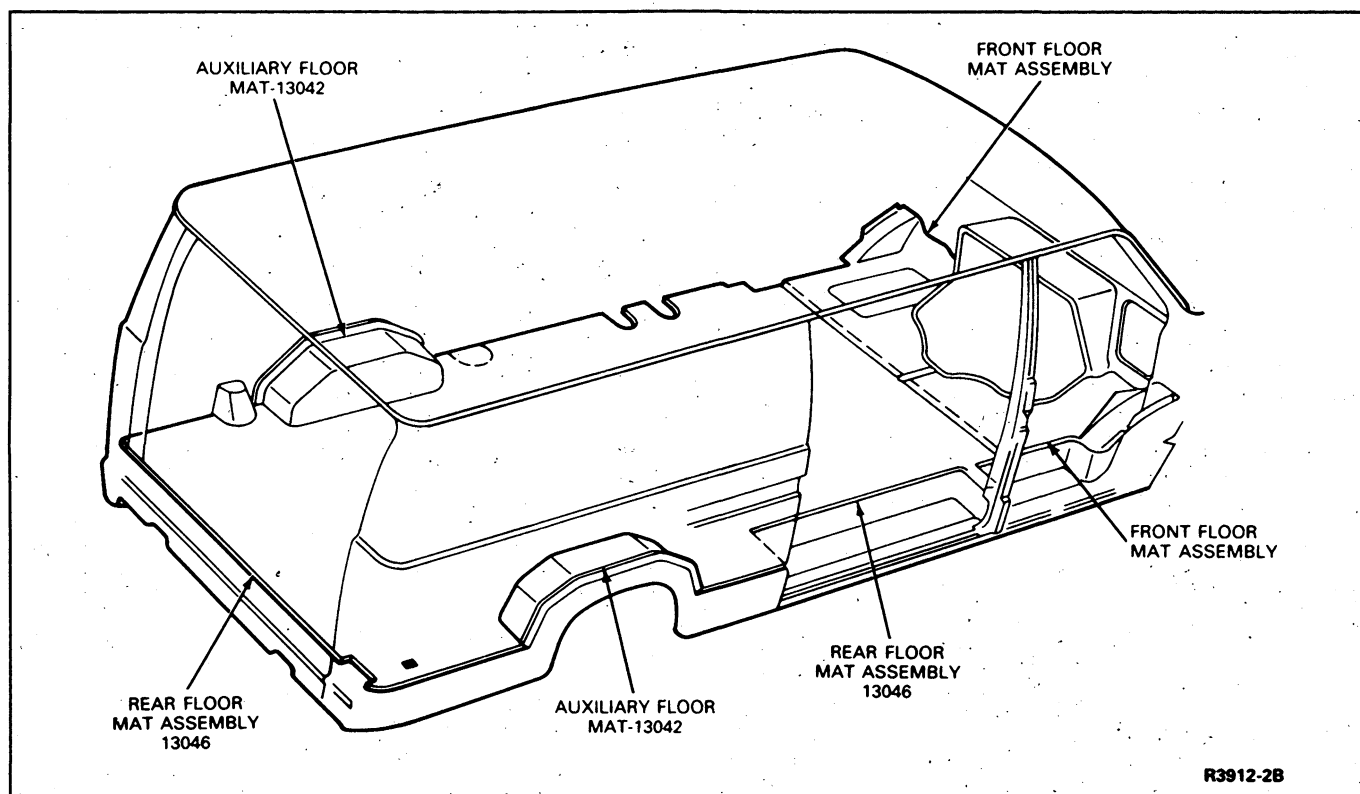


FIG. 18 Rear Floor Mats—E-150—E-350 Super Vans

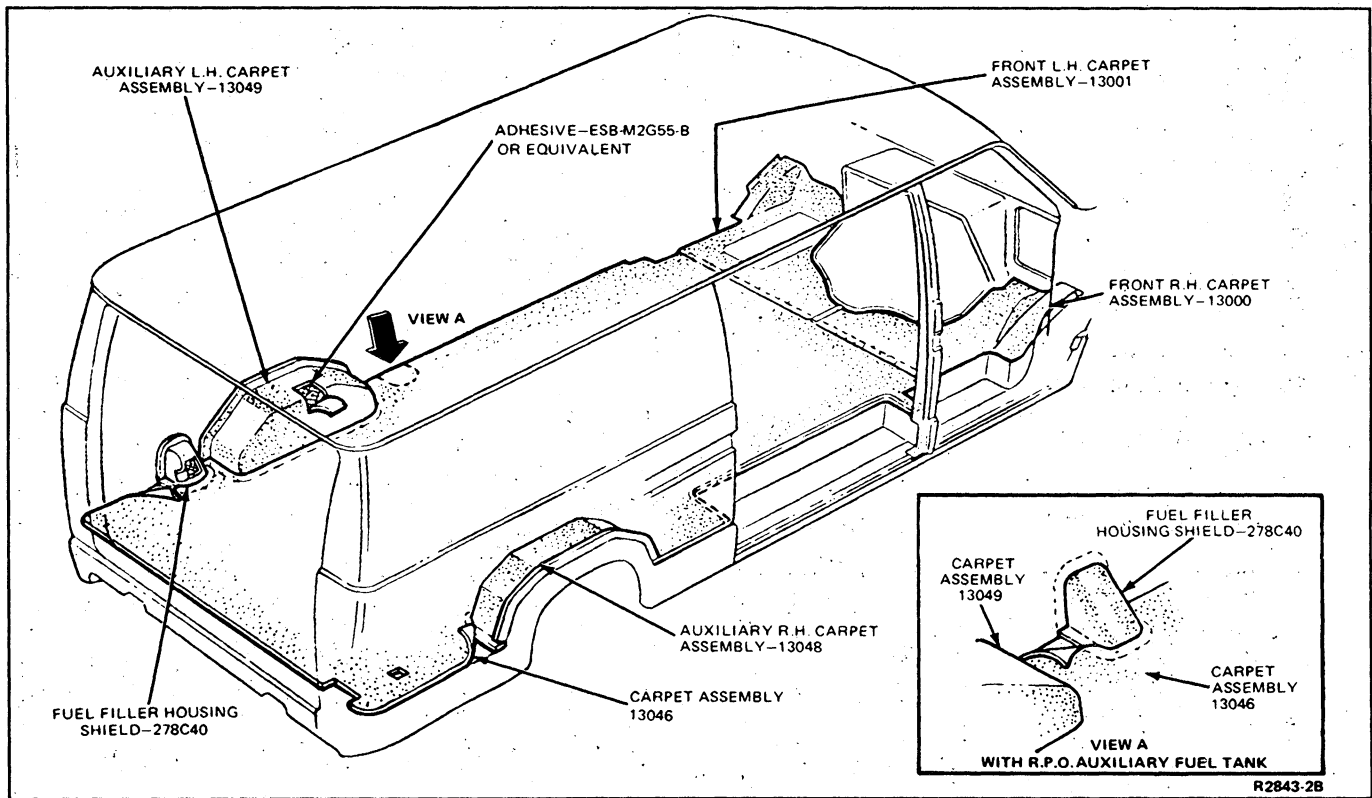


FIG. 19 Rear Floor Carpets—E-150—E-350 Super Vans and Wagons

## SECTION 45-31 Console Assembly

**SUBJECT****PAGE****SUBJECT****PAGE**

REMOVAL AND INSTALLATION ..... 45-31-1

VEHICLE APPLICATION ..... 45-31-1

**VEHICLE APPLICATION**

All F-150—F-350 (Super Cab) And Bronco.

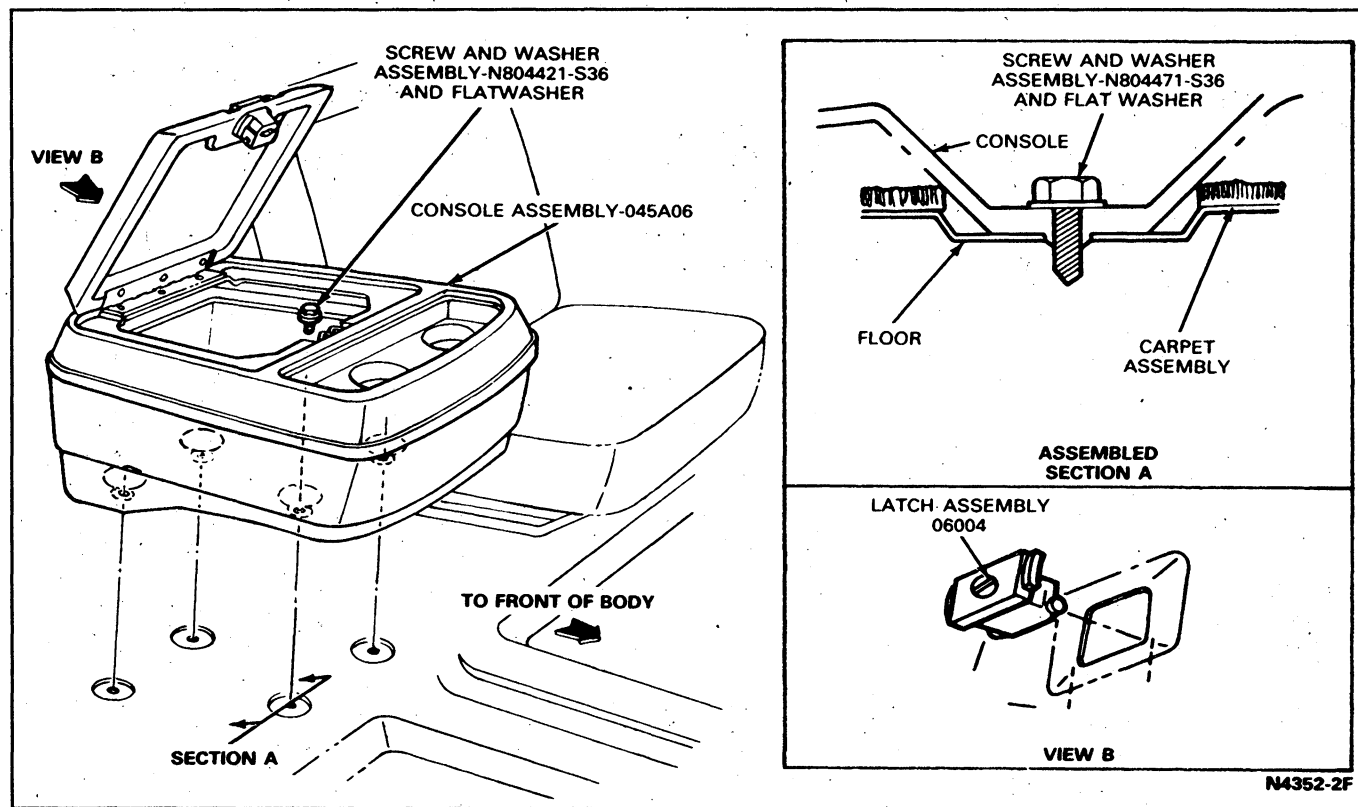
**REMOVAL AND INSTALLATION****Removal**

1. Remove the bolts from the base of the console panel (Fig. 1).

2. Remove the console.

**Installation**

1. Position console to floor of vehicle (Fig. 1).
2. Secure with bolts.

**FIG. 1 Console Assembly—Removal and Installation**

# SECTION 45-41 Headlining

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Cut and Score Headlining .....	45-41-2	Front Hard Headlining .....	45-41-1
Bronco .....	45-41-2	E-150—E-350 .....	45-41-1
F-150—F-350 .....	45-41-2	Full Length Hard Headlining .....	45-41-1
Cut and Sew Headlining .....	45-41-1	E-150—E-350 .....	45-41-1
E-150—E-350 .....	45-41-1	<b>VEHICLE APPLICATION</b> .....	45-41-1

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350, F-Super Duty and Bronco.

## REMOVAL AND INSTALLATION

### Front Hard Headlining

#### E-150—E-350

##### Removal

1. Remove the sun visor retaining screws and center retainer clip remove the sun visors (Fig. 1).
2. Remove side garnish moulding, if so equipped. Refer to Section 45-16, Mouldings.
3. Remove front dome lamp. Refer to Section 32-61, Interior Lamps.
4. Remove the six retaining screws from the rear of the trim panel.
5. Remove the centerline retaining screw (Fig. 2).
6. Slide the trim panel rearward out of the windshield header retaining strip (Fig. 2, View C).

##### Installation

1. Slide the trim panel forward into the windshield header retaining strip (Fig. 2, View C).
2. Install the centerline retaining screw (Fig. 2).
3. Install the six retaining screws at the rear of the trim panel.
4. Install the front dome lamp. Refer to Section 32-61, Interior Lamps.
5. Install the side garnish mouldings, if so equipped.
6. Install the sun visors (Fig. 1).

### Full Length Hard Headlining

#### E-150—E-350

##### Removal

1. Remove all garnish mouldings from the perimeter of the headliner (Figs. 3 and 4). Refer to Section 45-16, Mouldings.
2. Remove the front and rear dome lamps. Refer to Section 32-61, Interior Lamps.
3. Remove the metal end caps from the plastic trim panel retainers. Unsnap the plastic trim panel retainers from the metal supports.

4. Remove trim panel retaining screw located on the centerline of the vehicle (Fig. 2).
5. Bow each trim panel section downward at the center of the vehicle and remove the trim panel from the retainers.

##### Installation

1. Position the trim panel to the retainers by bowing the trim panel.
2. Install the trim panel retaining screw located on the centerline of the vehicle (Fig. 2).
3. Snap the plastic trim panel retainers to the metal supports. Install the metal end caps to the plastic trim panel retainers.
4. Install the front and rear dome lamps. Refer to Section 32-61, Interior Lamps.
5. Install all garnish mouldings to the perimeter of the headliner (Fig. 3). Refer to Section 45-16, Mouldings.

### Cut and Sew Headlining

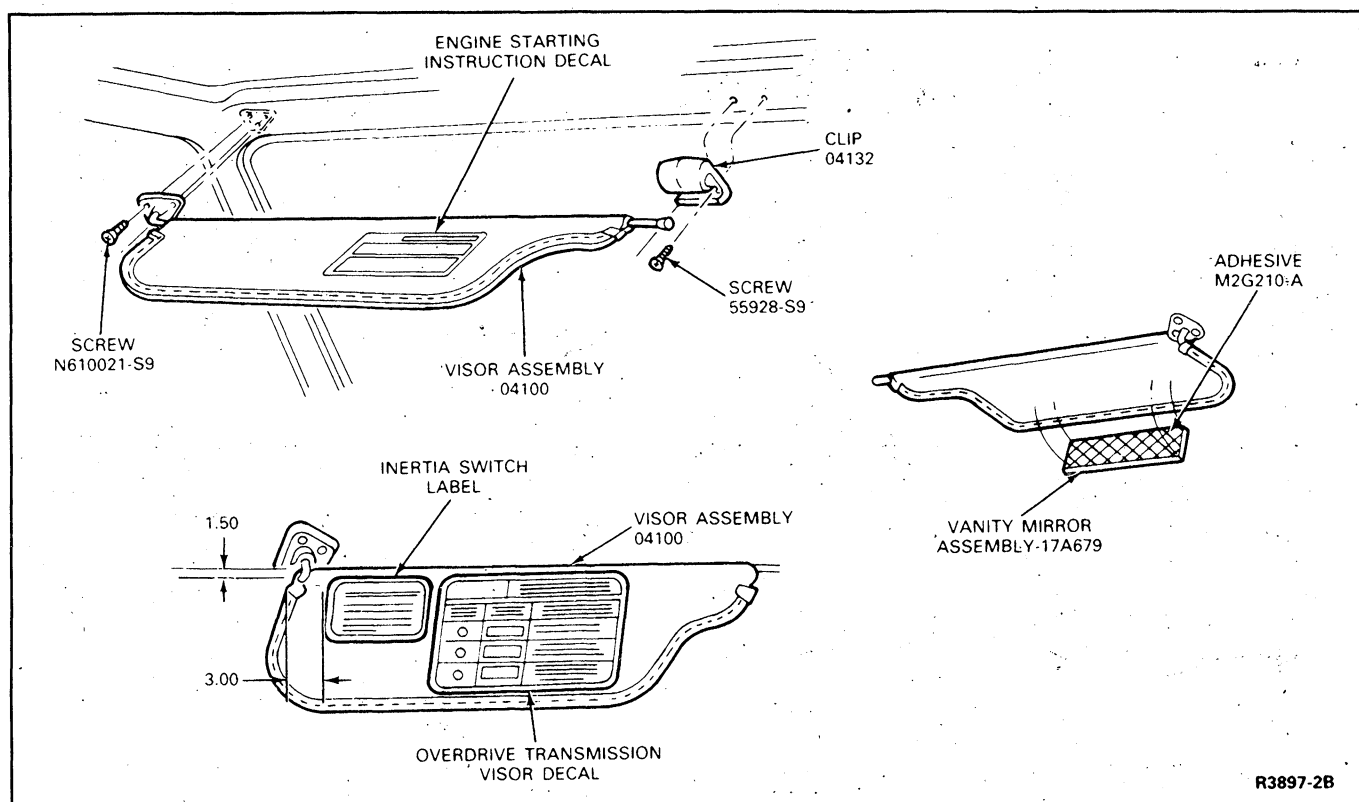
#### E-150—E-350

##### Removal

1. Remove sun visor(s) (Fig. 1).
2. Remove windshield garnish and all side mouldings from headlining. Refer to Section 45-16, Mouldings.
3. Unhook headlining from retainer tabs (Figs. 5, 6 and 7).
4. Remove front and rear dome lamps. Refer to Section 32-61, Interior Lamps.
5. Pull headlining loose from all cemented areas.
6. Disengage all support rods from holes in LH and RH roof rails (Figs. 8 and 9).
7. Remove headlining from center retaining clips and remove from vehicle.

##### Installation

1. Unpackage the new headlining and lay it out on a flat surface.
2. Trim the listings (or "pockets") on the new headlining to the approximate length of those on the old one. Remove the support rods from the old headlining. Install them in the same relative rod listings of the new headlining.



R3897-2B

FIG. 1 Sun Visors—E-150—E-350

**Roof headlining support rods are color coded at each end. When ordering new rods, be sure to note the color at each end of the rod.**

3. Position the headlining in the vehicle.
4. Insert support rods into holes in RH and LH roof rails (Figs. 8 and 9).
5. Snap headlining into center retaining clips.
6. Starting from center to outboard side, stretch headlining to back roof line and hook headlining on retainer.
7. Repeat Step 6, stretching to the sides.
8. Cement the headlining at points marked (Fig. 5).
9. Trim excess material.
10. Install windshield garnish and all side mouldings.
11. Install the sun visor(s) (Fig. 1).
12. Install front and rear dome lamps.

### Cut and Score Headlining

#### Bronco

##### Removal

1. Remove the three screws retaining each sun visor to the roof and remove the sun visors (Fig. 10).
2. Remove the screws retaining the garnish mouldings and remove the mouldings.
3. Remove the two drive pins retaining the headliner to the roof structure. Remove the headliner (Fig. 11).

##### Installation

1. Position the headliner to the roof and install two drive pins to retain the headliner.

2. Position garnish mouldings and install retaining screws.
3. Position sun visors to headliner and install retaining screws.

#### F-150—F-350

##### Removal

1. Remove both sun visors and retainer clips (Fig. 10).
2. Remove the windshield upper garnish moulding. Refer to Section 45-16, Mouldings.
3. Remove the roof side inner front mouldings (Figs. 12, 13 and 14).
4. Loosen the windshield side mouldings.
5. Remove the rear window upper moulding.
6. Loosen the pillar moulding on both sides.
7. Remove the dome lamp lens.
8. Remove the dome lamp assembly. Refer to Section 32-61, Interior Lamps.
9. Remove the roof trim panel.

##### Installation

1. Preshape new headliner along score marks to approximately same shape as old headliner.
2. Position the headliner to roof.
3. Install the dome lamp assembly. Refer to Section 32-61, Interior Lamps.
4. Install the visors.
5. Install the garnish and tighten mouldings (Figs. 12, 13 and 14).

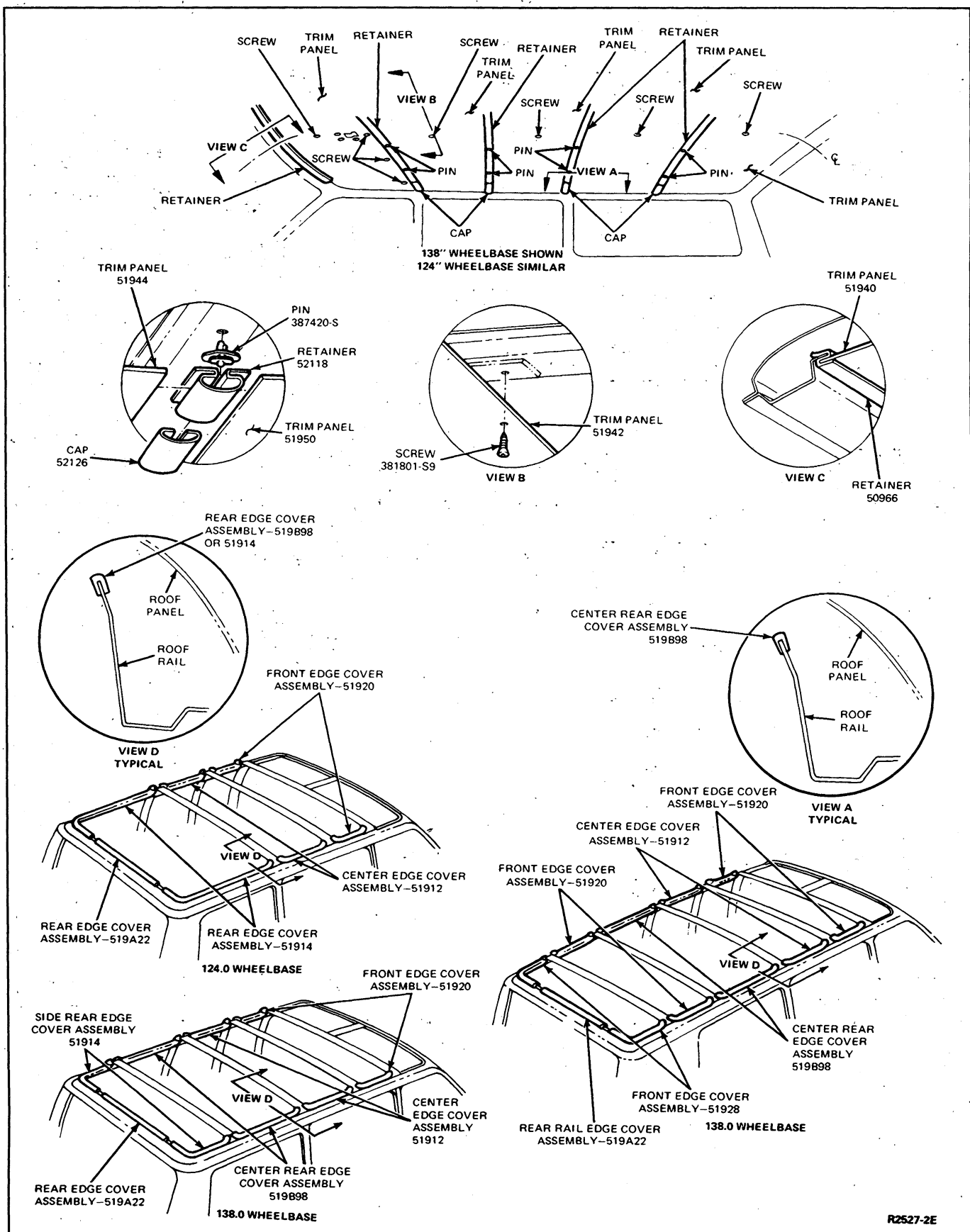


FIG. 2 Roof Trim Panels—E-150—E-350—124 inch and 138 inch Wheel Base Shown—Others Typical

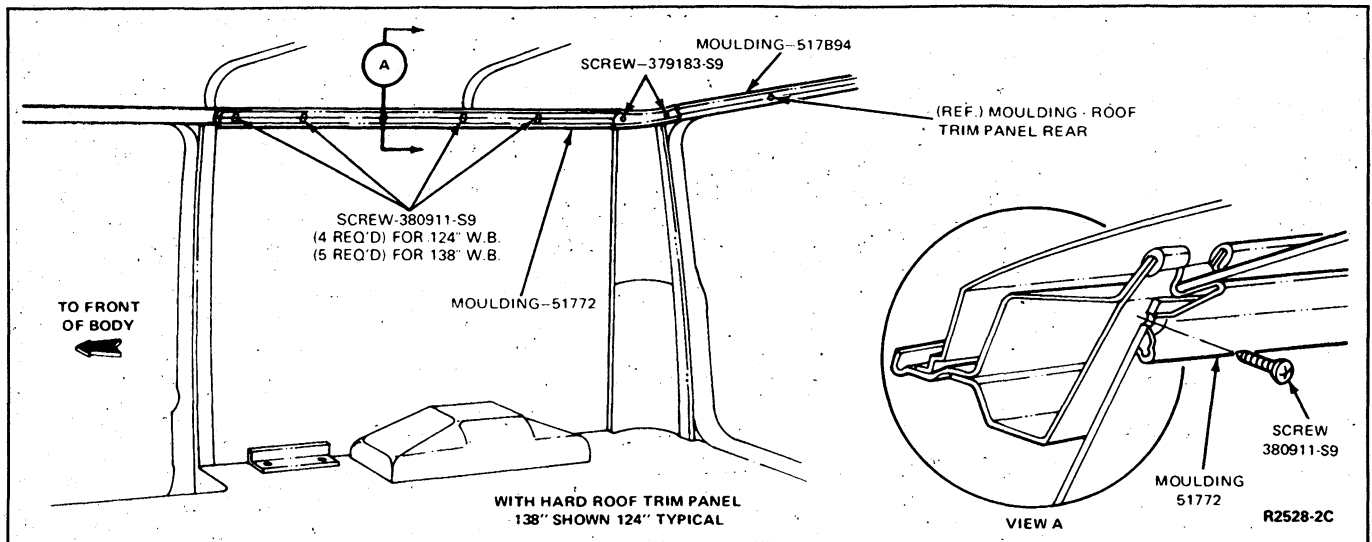


FIG. 3 Interior Roof Mouldings—E-150—E-350—Hard Roof Trim Panels

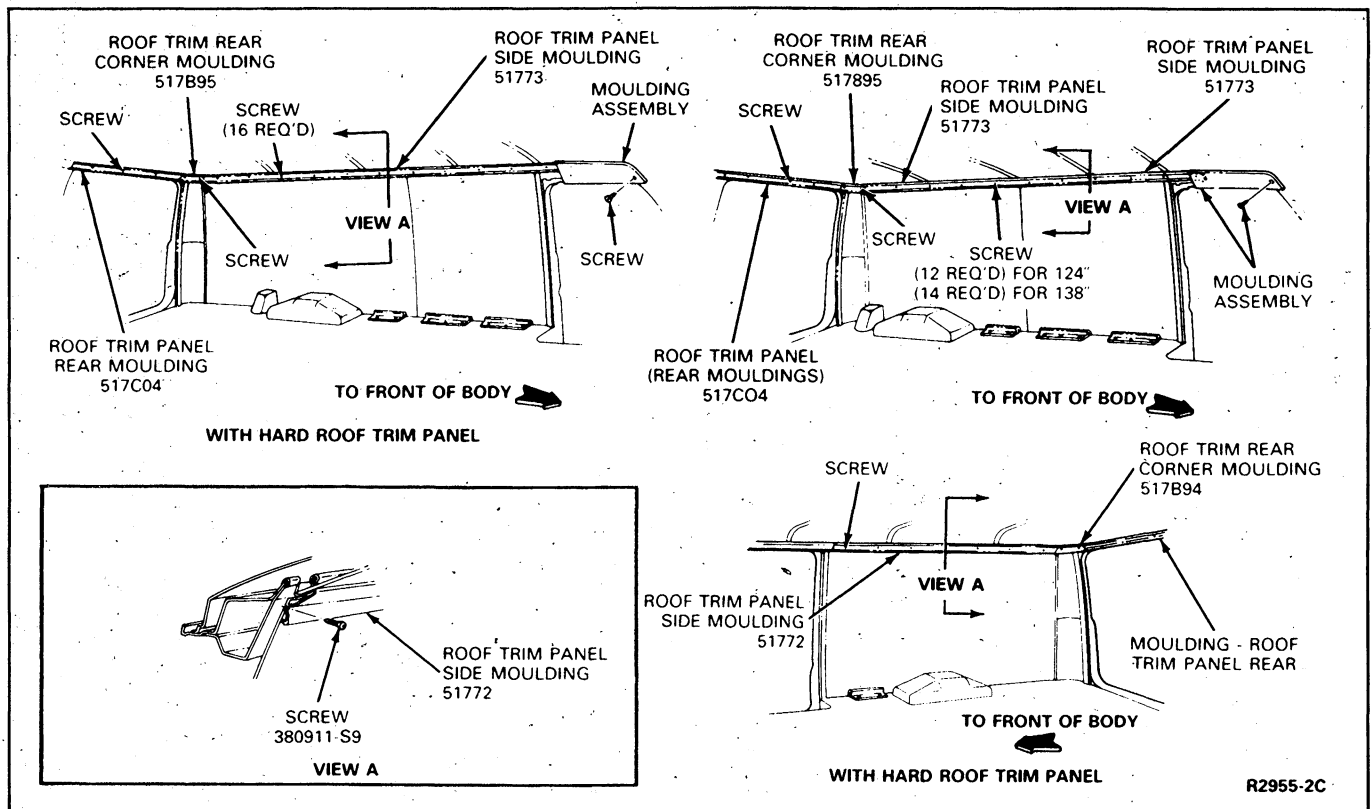


FIG. 4 Interior Roof Trim Panels—Captain's Chateau Package-E-150—E-350

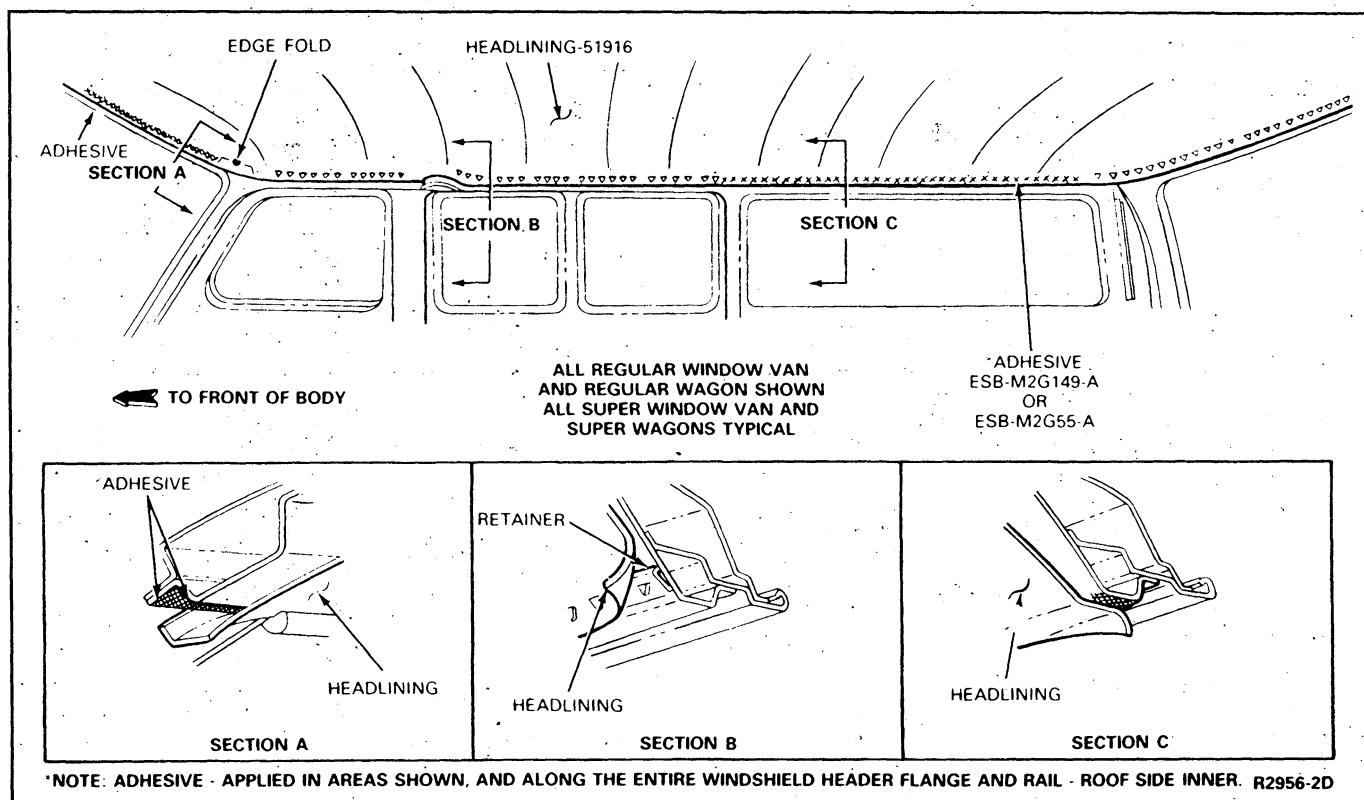


FIG. 5 R.P.O. Headlining Assembly—E-150—E-350

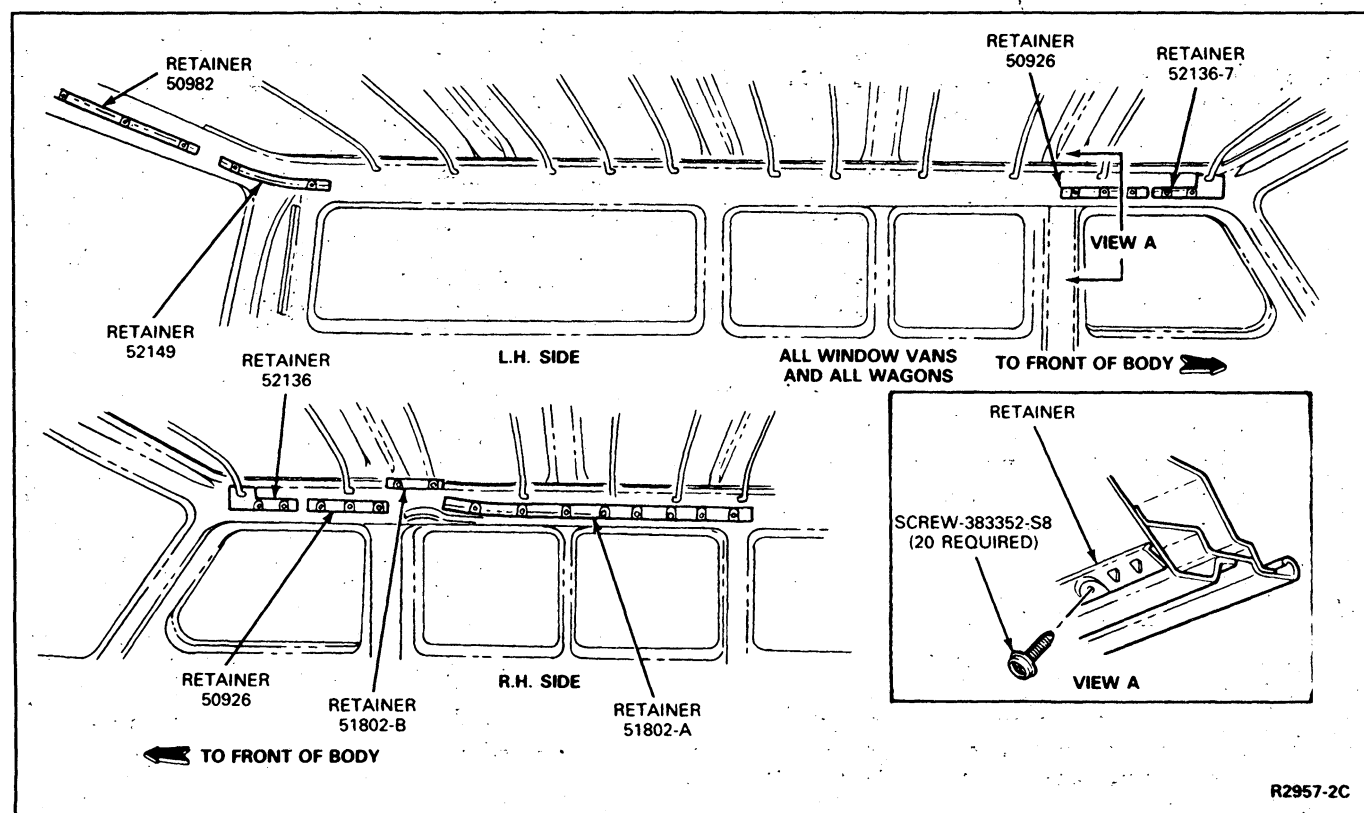


FIG. 6 R.P.O. Headlining Retainers—E-150—E-350 Sliding Door



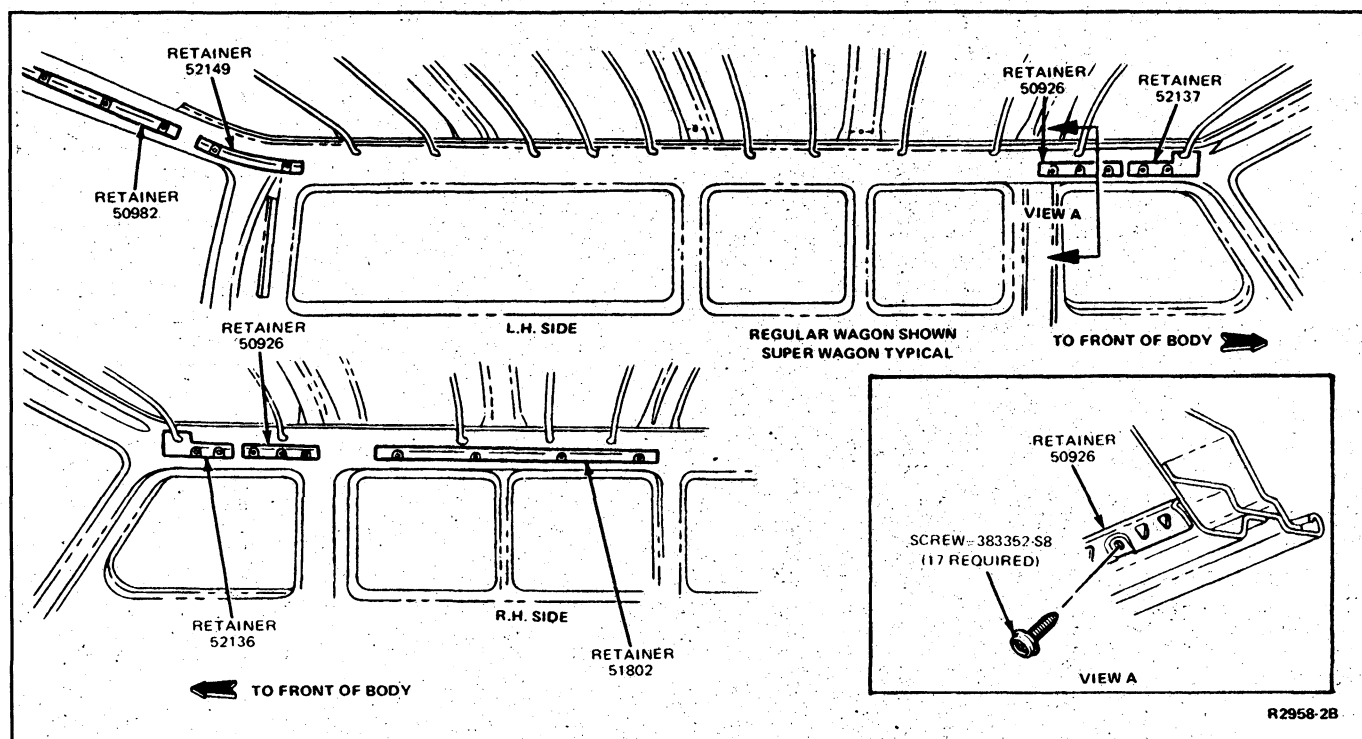


FIG. 7 R.P.O. Headlining Retainers—E-150—E-350 Hinged Door

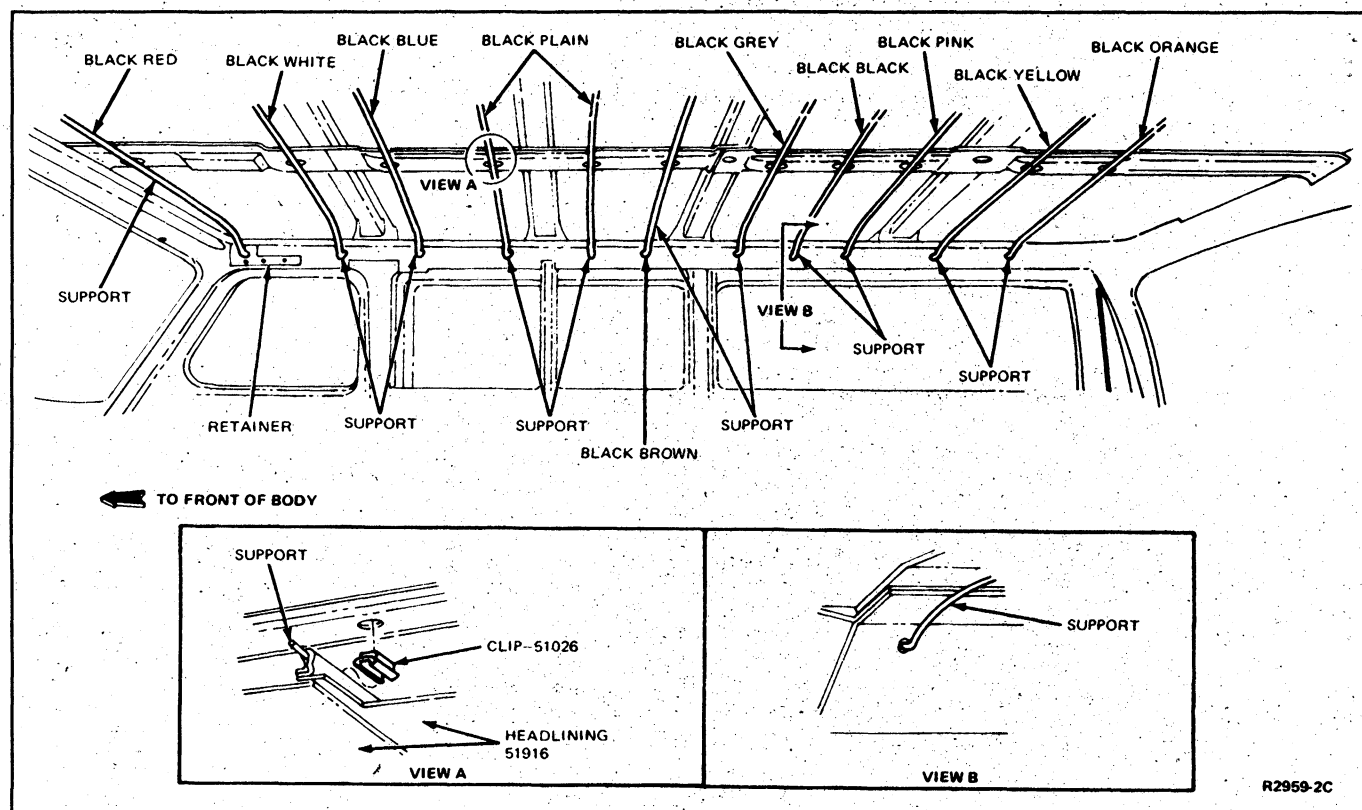


FIG. 8 R.P.O. Headlining Supports—E-150—E-350 138 Inch W.B.

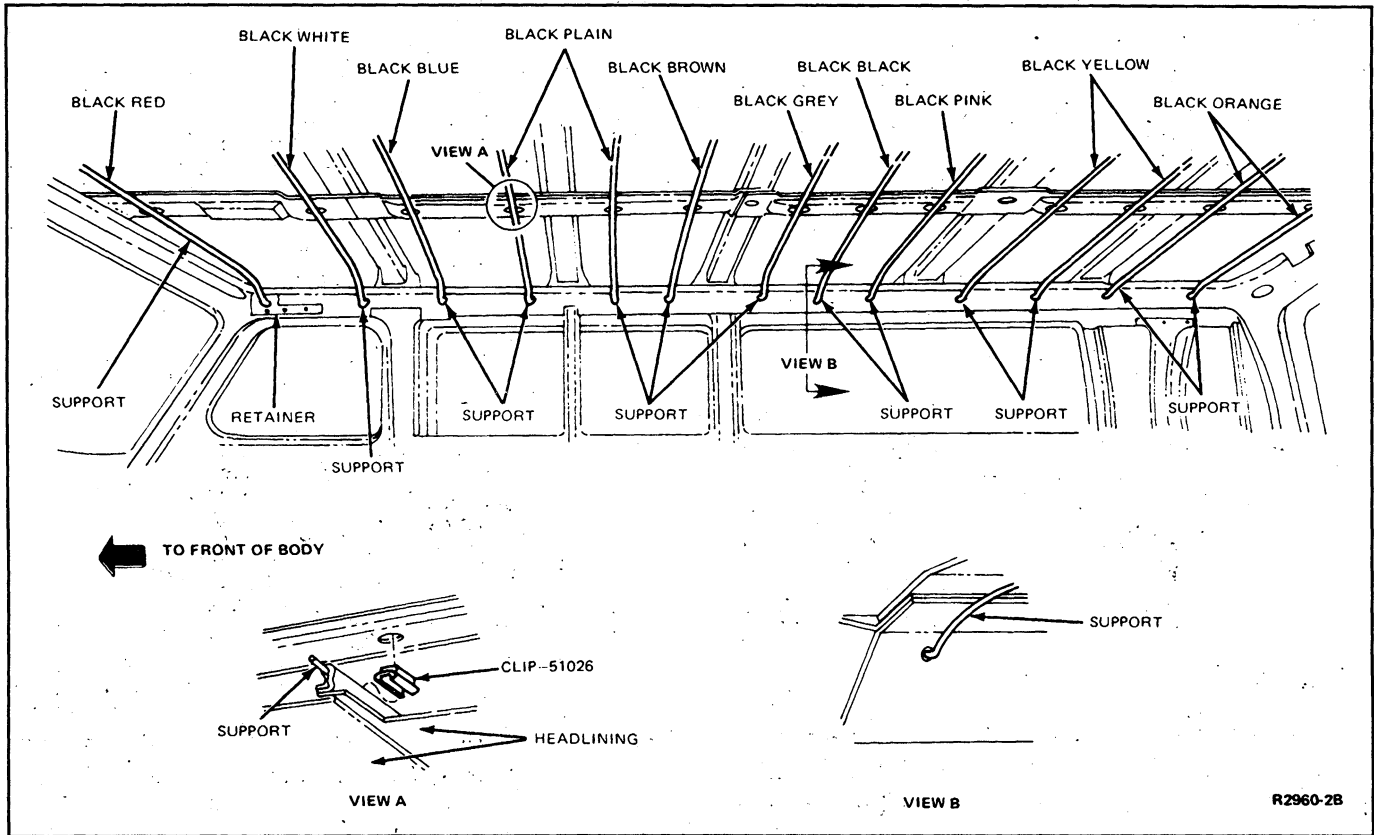


FIG. 9 R.P.O. Headlining Supports—E-150—E-350 Super Van and Super Wagon—138 Inch W.B.

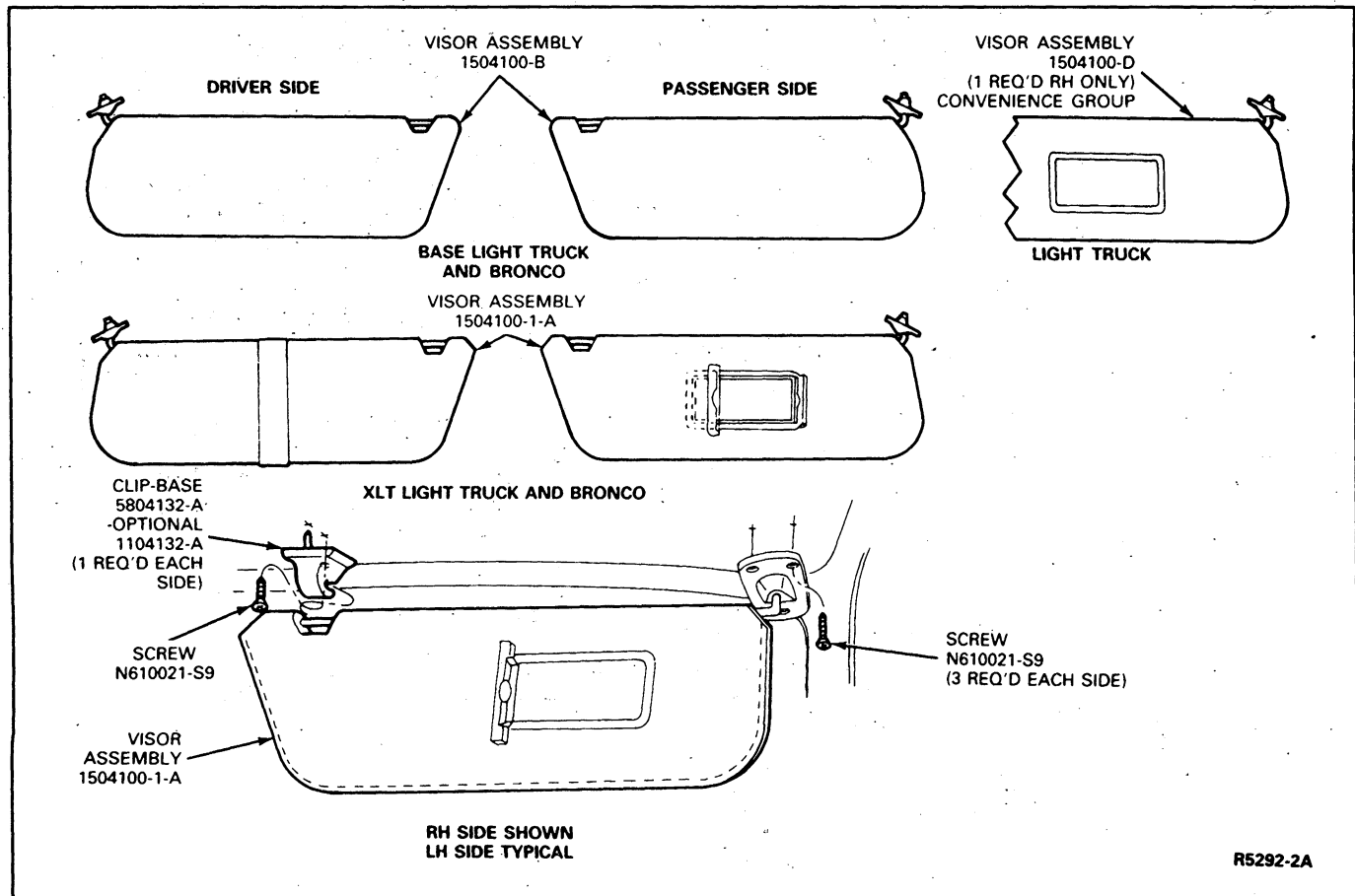


FIG. 10 Sun Visors—F-150—F-350 and Bronco

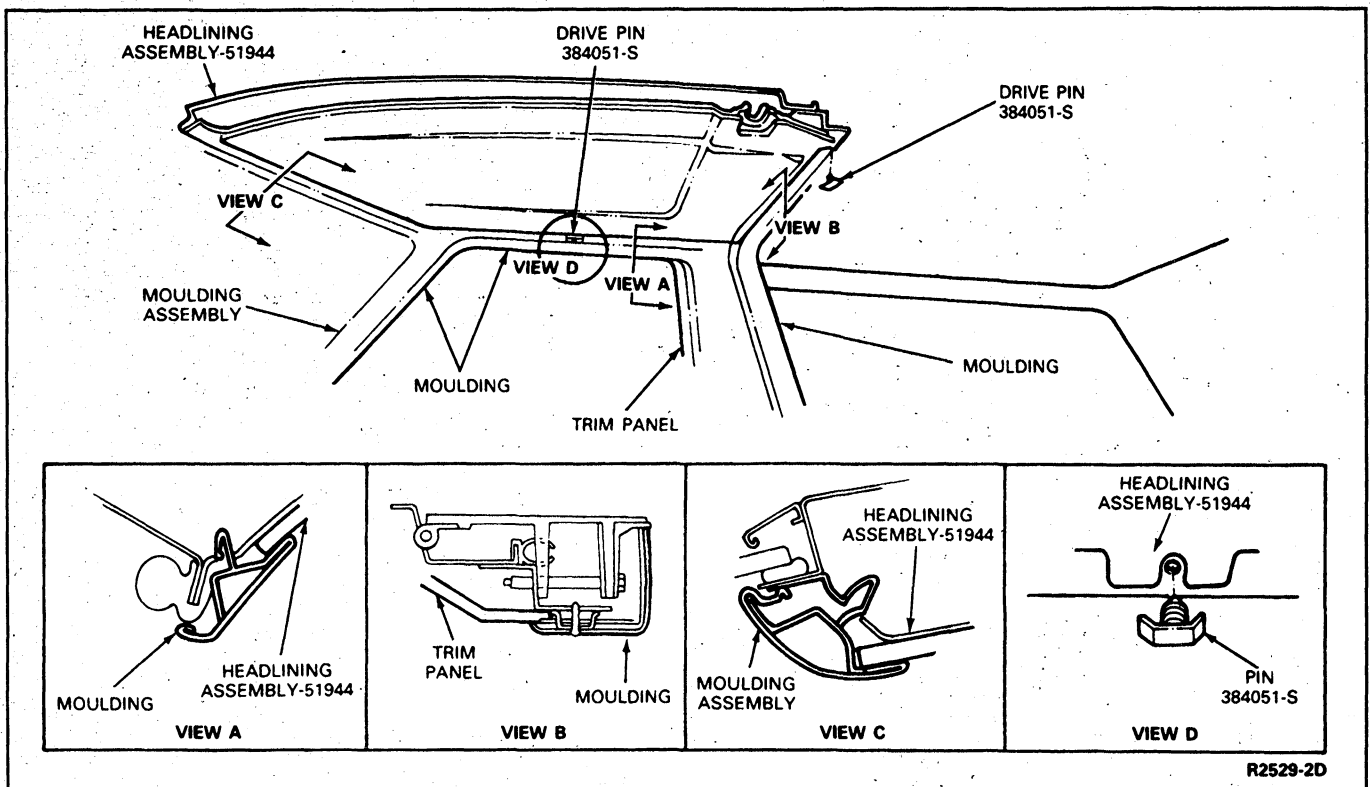


FIG. 11 Roof Trim Panel Installation Bronco

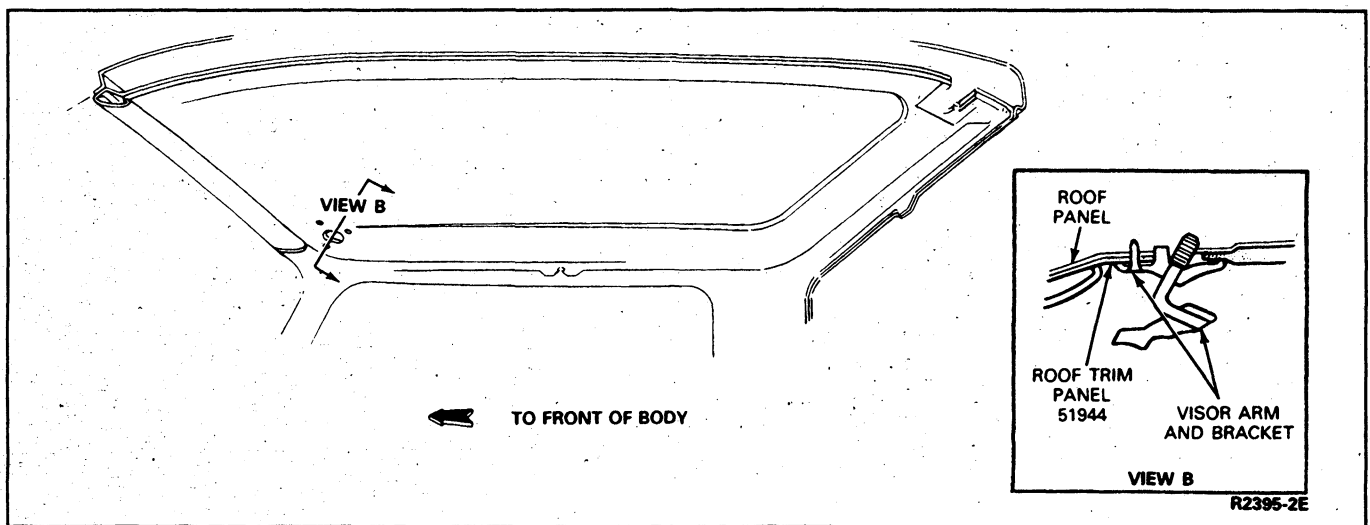


FIG. 12 Roof Headlining Assembly—F-150—F-350 and F-Super Duty

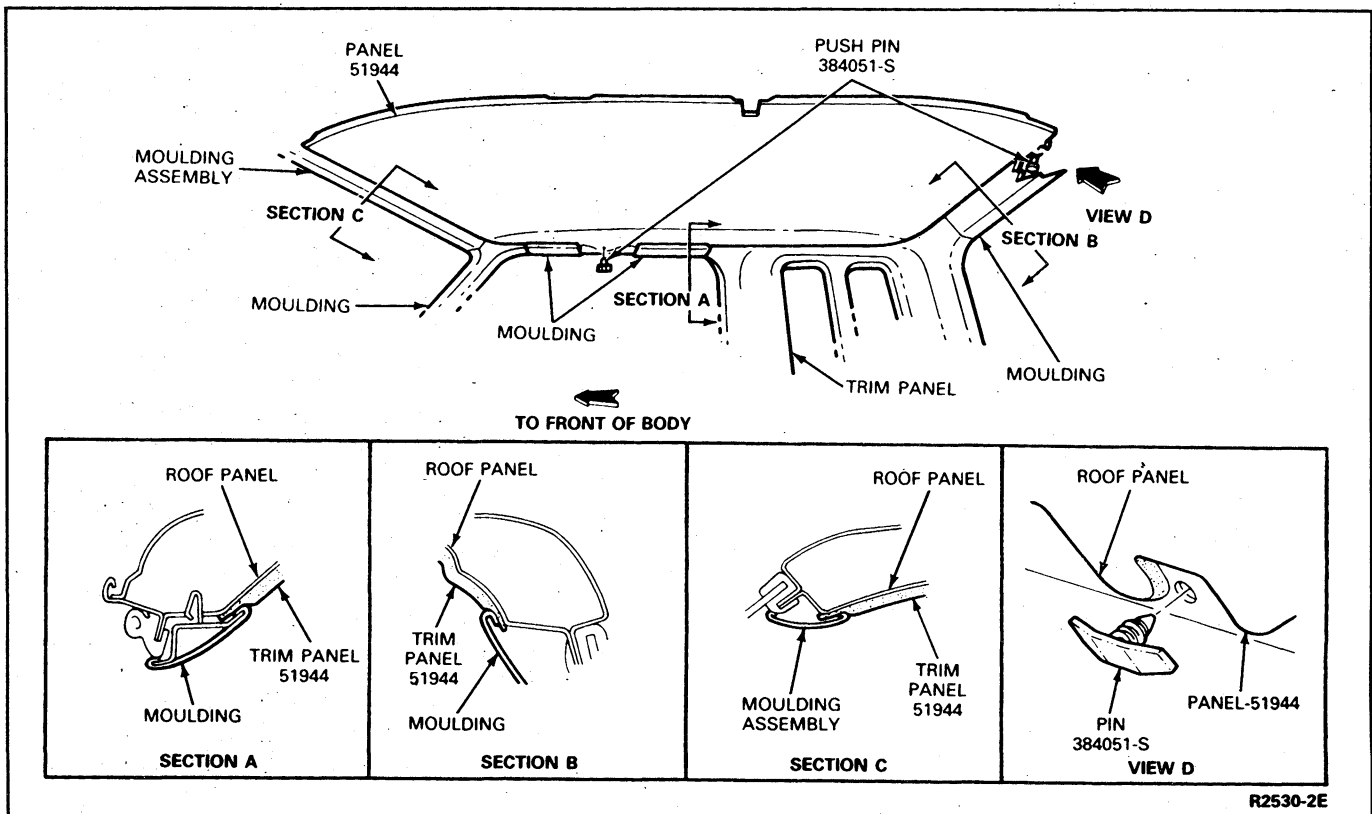


FIG. 13 Roof Trim Panel Installation—F-150—F-350 Super Cab

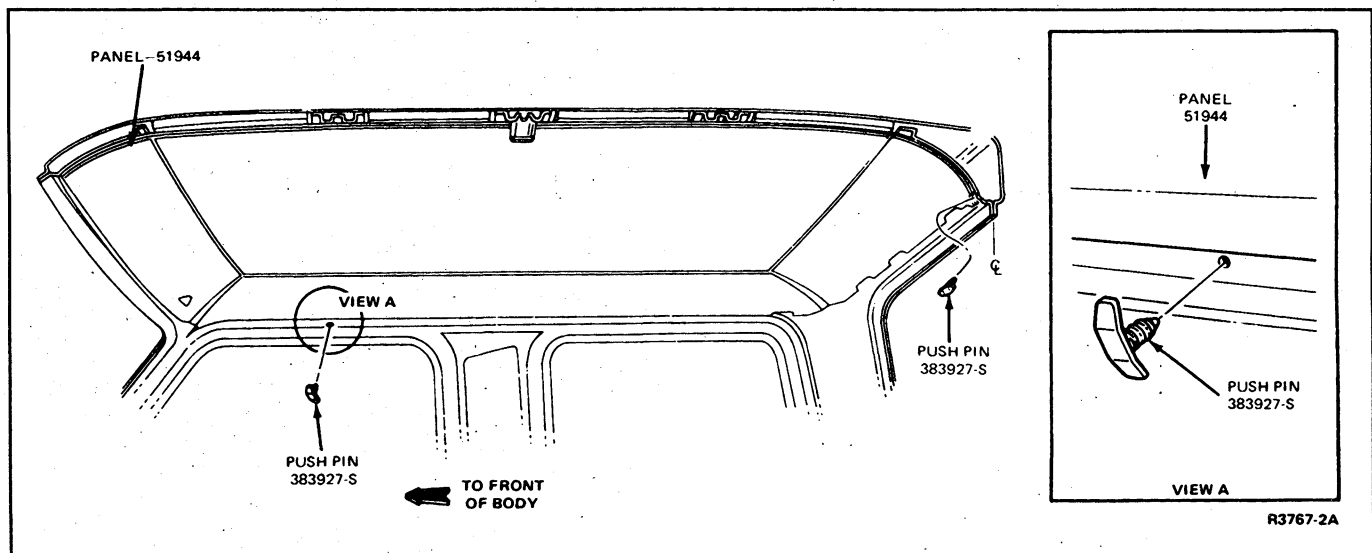


FIG. 14 Roof Trim Panel Installation—F-350 Crew Cab

# SECTION 45-61 Instrument Panel and Pad

## SUBJECT

## PAGE

### REMOVAL AND INSTALLATION

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Instrument Panel ..... 45-61-1

## SUBJECT

## PAGE

VEHICLE APPLICATION ..... 45-61-1

## VEHICLE APPLICATION

E-150—E-350, F-150—F-350, F-Super Duty and Bronco.

## REMOVAL AND INSTALLATION

### E-150—E-350 and Club Wagon

#### Instrument Panel Pad

##### Removal

1. Remove the battery ground cable.
2. Remove headlamp switch bezel, knob and shaft assembly.
3. Remove two screws at bottom of LH finish panel and pull rearward to disengage friction cups (Fig. 1). Disconnect wiring connectors and remove panel.
4. Remove four screws at bottom of instrument cluster finish panel and three screws at top of panel. Pull rearward and disconnect cluster wiring connectors, speedometer and remove instrument cluster (Fig. 2).

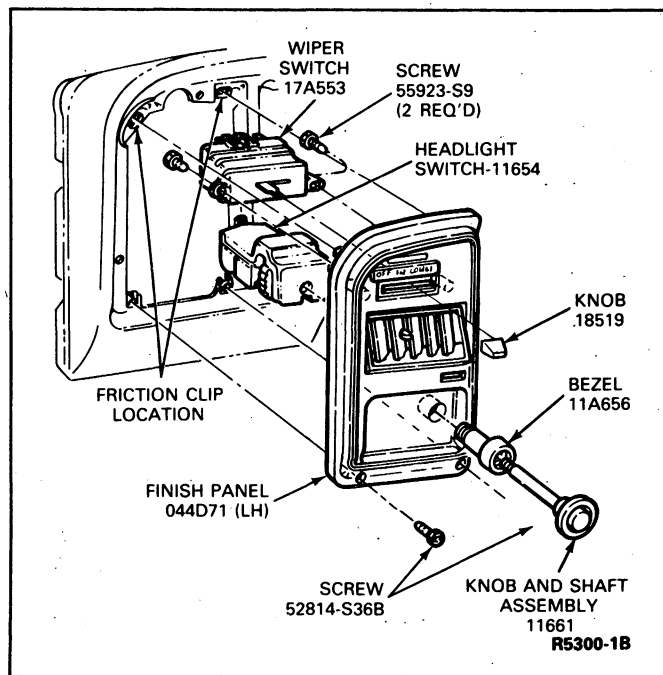


FIG. 1 Instrument Panel Installation LH Side—E-150-350

5. Remove three screws at bottom of RH finish panel and two screws at top of panel, over radio. Pull rearward to disengage friction clips (Fig. 3).
6. Disconnect cigar lighter wiring, if so equipped.
7. Remove radio, if so equipped.
8. Remove A/C register grille from RH end of instrument panel pad.
9. Reach under panel through openings made by removal of panels and remove eleven pad attaching nuts (Fig. 4). Remove pad.

NOTE: To remove the RH nuts it is necessary to approach from the underside of the instrument panel with an extension tool.

##### Installation

1. Position instrument panel pad in place. Install retaining nuts and tighten to 2.03-3.39 N·m (18-30 in-lb).
2. Install A/C grille vents.
3. Install radio, if so equipped.
4. Position RH finish panel in place, connect cigar lighter wiring and install two upper screws and three lower screws.
5. Connect wiring connectors and speedometer cable to instrument cluster and position instrument cluster in place. Install three top retaining screws and four bottom retaining screws.
6. Connect wiring connectors to LH finish panel. Position panel in place, and install two bottom retaining screws.
7. Install headlamp switch bezel, knob and shaft assembly.
8. Connect battery ground cable.

#### Instrument Panel

##### Removal

1. Disconnect battery ground cable.
2. Remove steering wheel. Refer to Section 13-06, Steering Column—Shift Rod Within Tube.
3. Remove instruments, clusters and controls. Refer to Group 33.
4. Remove heater/air conditioning control. Refer to Section 36-65, E-150 through E-350 Air Conditioning System.
5. Disconnect and remove cigar lighter.
6. If so equipped, remove radio and instrument panel mounted speaker. Refer to Section 35-01, Radios

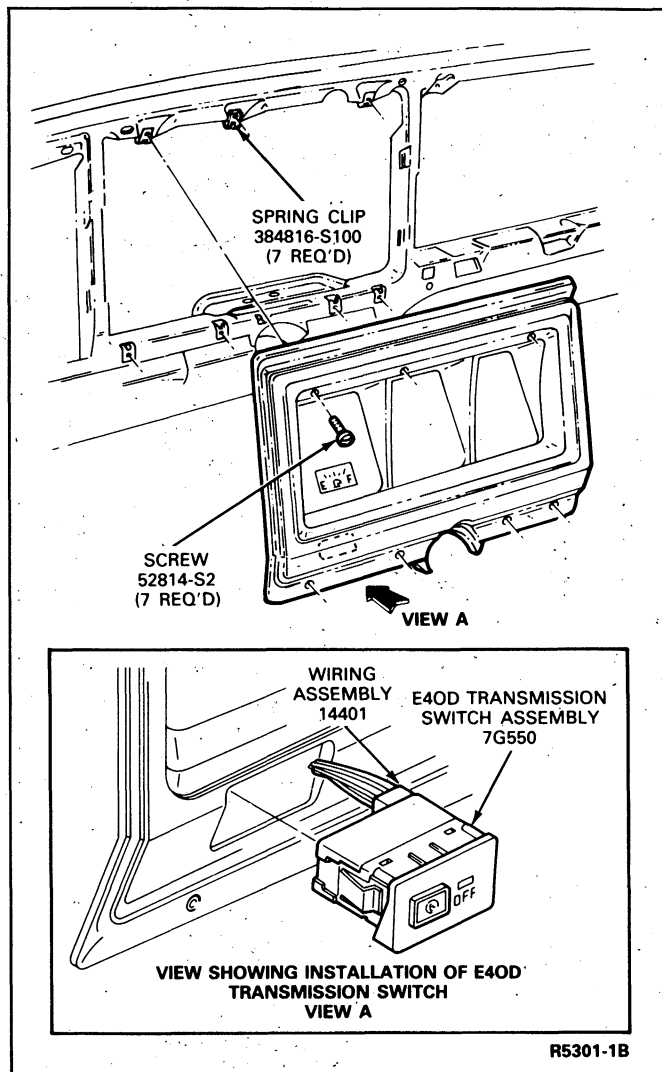


FIG. 2 Instrument Cluster Installation

and Premium Sound System and Section 35-31, Speakers.

7. Remove 11 nuts securing pad to instrument panel (Fig. 4) and remove pad. Use care to prevent damage to pad.
8. Remove steering column cover.
9. Remove instrument panel upper moulding.
10. Remove two screw and washer assemblies securing instrument panel to brake and clutch pedal support bracket assembly.
11. Remove screw and washer assembly securing the instrument panel at lower support bracket.
12. While supporting the instrument panel, remove two side attaching screw and washer assemblies. Carefully remove instrument panel from vehicles.

#### Installation

1. Carefully position instrument panel in vehicle and secure with two side attaching screw and washer assemblies tightened to 15-28 N·m (11-21 ft-lb) (Fig. 4).
2. Secure instrument panel to supports with three screw and washer assemblies tightened to 17-27 N·m (12-20 ft-lb).

3. Install instrument panel upper moulding. Tighten screws to 14-20 N·m (10-15 in-lb).
4. Install steering column cover. Tighten screws to 14-20 N·m (10-15 in-lb).
5. Install instrument panel pad. Tighten nuts to 11-27 N·m (8-20 in-lb).
6. Install all auxiliary equipment and controls removed during removal procedure.
7. Install instruments, clusters and controls. Refer to Group 33.
8. Install steering wheel. Refer to Section 13-06, Steering Column—Shift Rod Within Tube.
9. Connect battery ground cable.

#### Instrument Panel

F-150 — F-350 — F-Super Duty and Bronco.

#### Removal

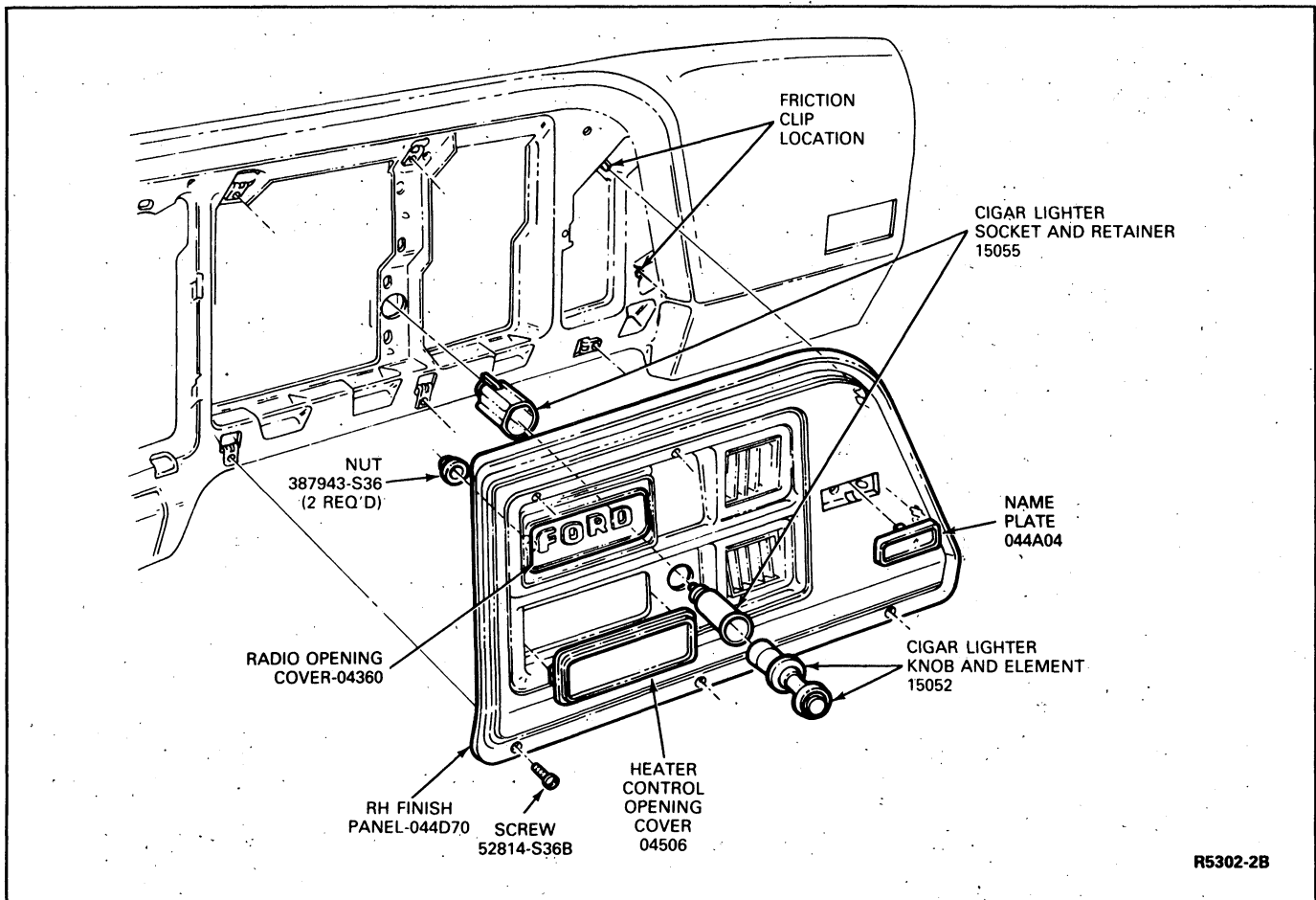
1. Disconnect battery ground cable.
2. Working beneath instrument panel, remove nut and washer assembly attaching panel to brake and clutch pedal support (Fig. 5).
3. Remove bolt attaching instrument panel to panel dash brace.
4. Remove four quick operating quarter turn pins securing instrument panel steering column opening cover assembly to underside of instrument panel. Remove cover.
5. Remove screw and washer assembly, located in lower outer corner on each side of instrument panel, securing panel to cowl side panel.
6. Disconnect connectors from main wiring harness (14401) to: (1) the blower ON-OFF switch and lever assembly, (2) to A/C control switch and pushbutton assembly, and (3) the control assembly illumination bulb.
7. Disconnect hoses from vacuum valve which is operated by the outside air control lever.
8. Disconnect function and temperature control cables from control assembly as outlined.
9. Remove tapping screws securing upper, leading edge of instrument panel to top of dash panel at four locations.
10. Lift instrument panel assembly upward and over steering column and wheel.

#### Installation

1. Position instrument panel so that four holes near forward edge of panel align with mating holes near upper edge of dash panel.

NOTE: The self-tapping screws used to attach the panel at these four locations turn into insert nuts in the dash panel. If any of these nuts (part number N805217) are damaged, they should be replaced.

2. Connect function and temperature control cables to respective levers in control assembly as outlined.
3. Connect vacuum hoses to vacuum valve in control assembly.
4. Connect wiring connector for blower ON-OFF switch, A/C control switch, and control assembly illumination bulb.



R5302-2B

**FIG. 3 Instrument Panel Installation RH Side—E-150-350**

5. Attach lower, outer corners of instrument panel to cowl side panel.
6. Install instrument panel steering column opening cover on instrument panel.
7. Install volt attaching instrument panel to dash panel brace.
8. Install nut and washer assembly attaching instrument panel to brake and clutch pedal support.
9. Connect battery ground cable.

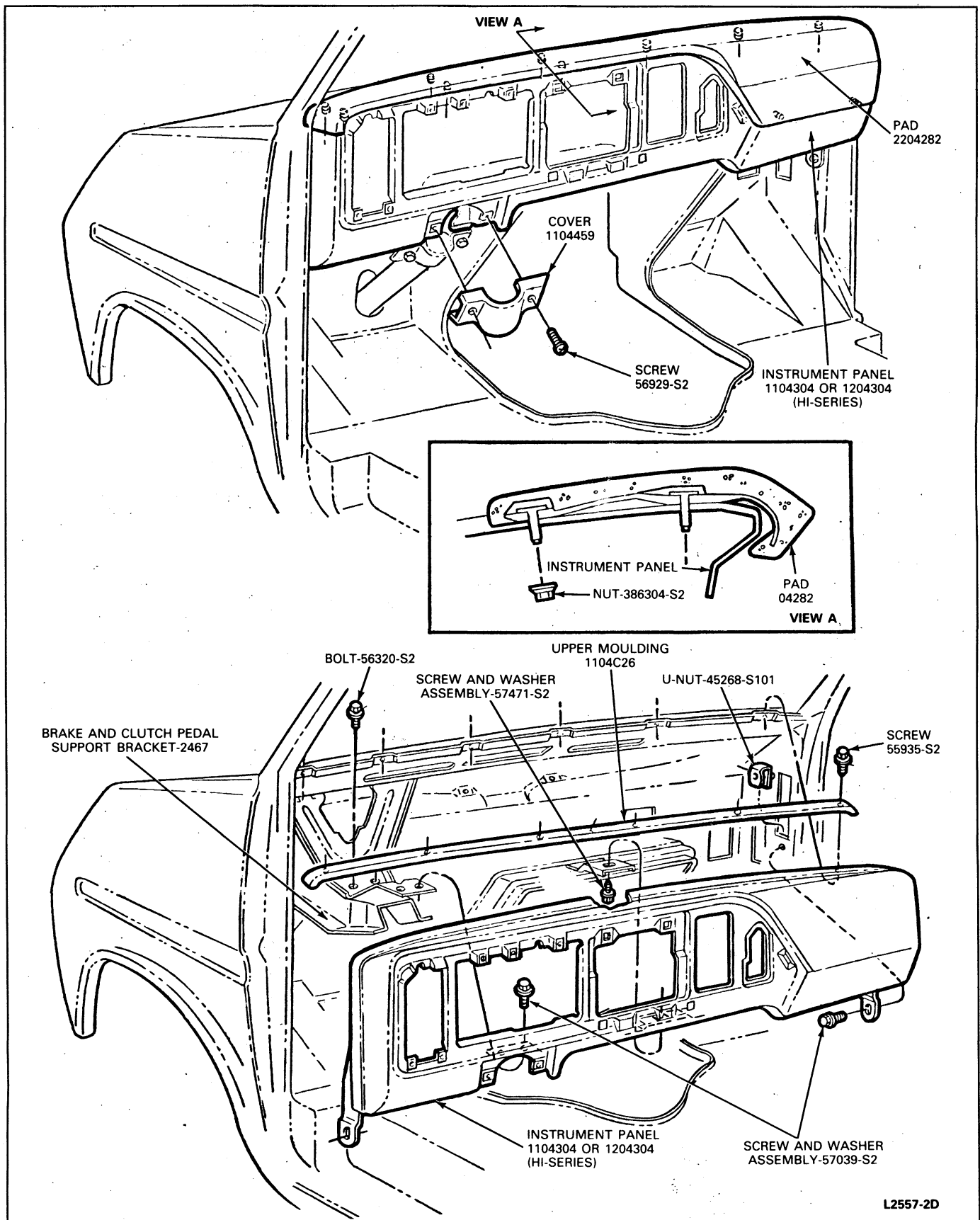


FIG. 4 Instrument Panel Installation—E-150—E-350 and Club Wagon



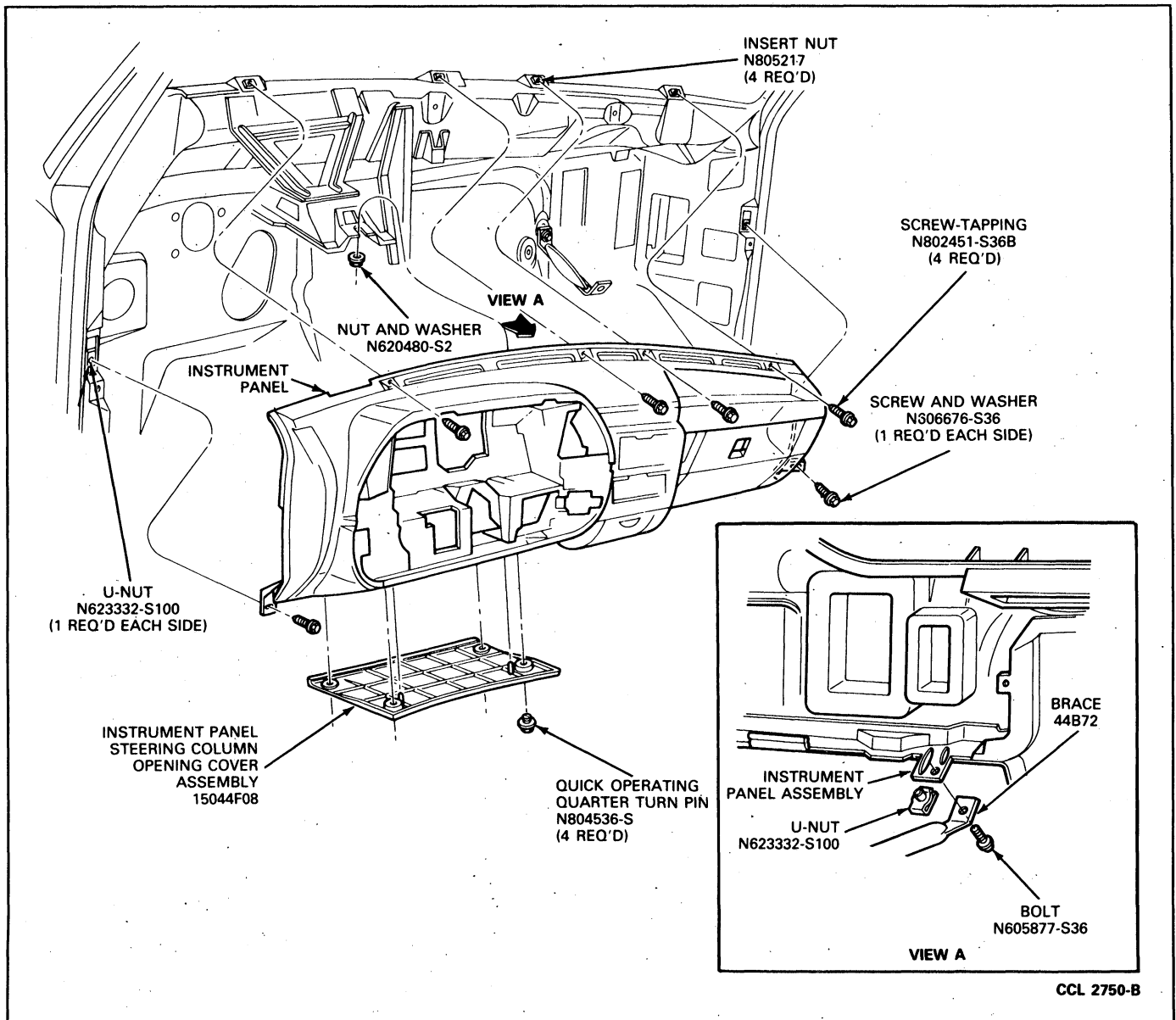


FIG. 5 Instrument Panel—F-150—F-350, F-Super Duty and Bronco

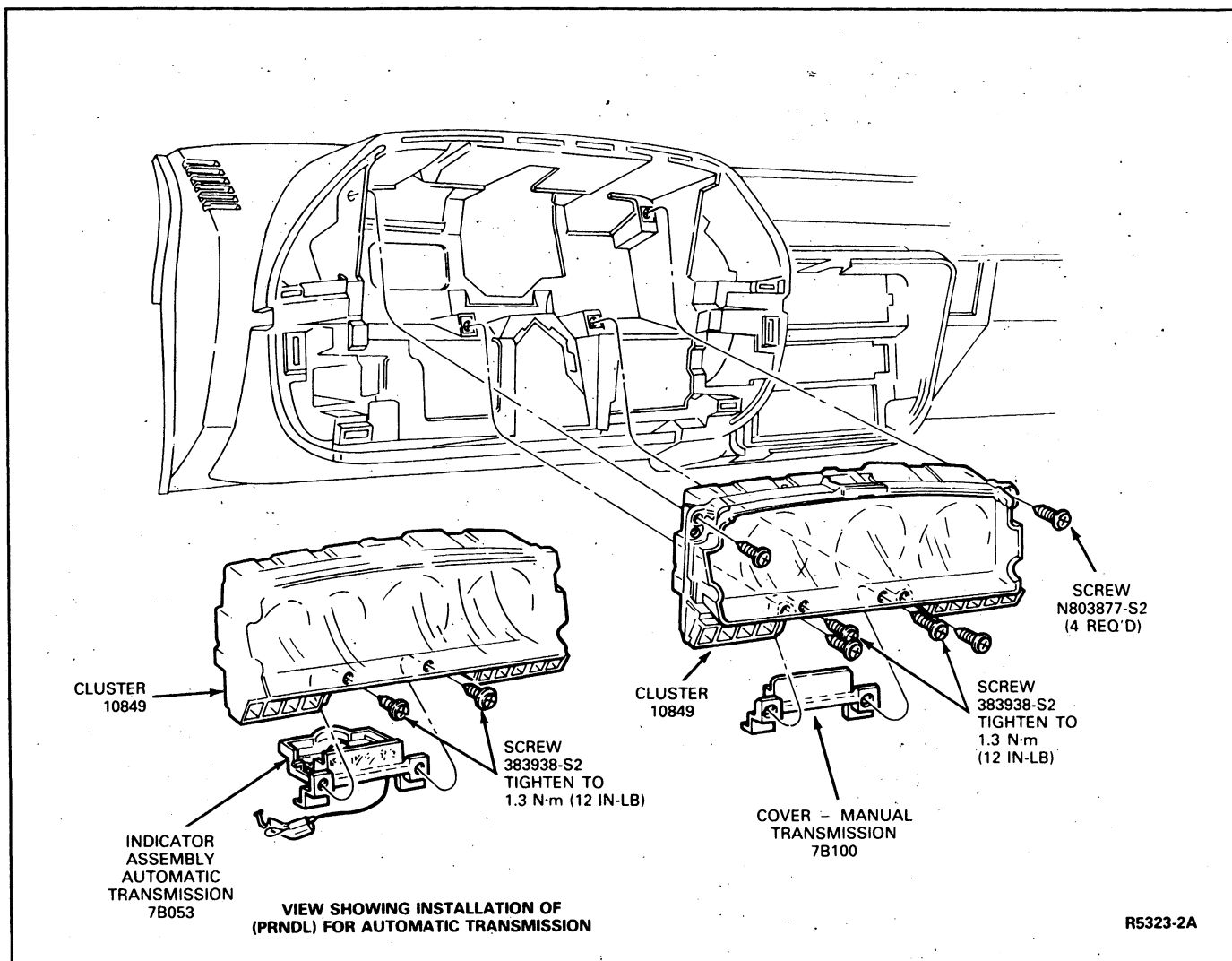
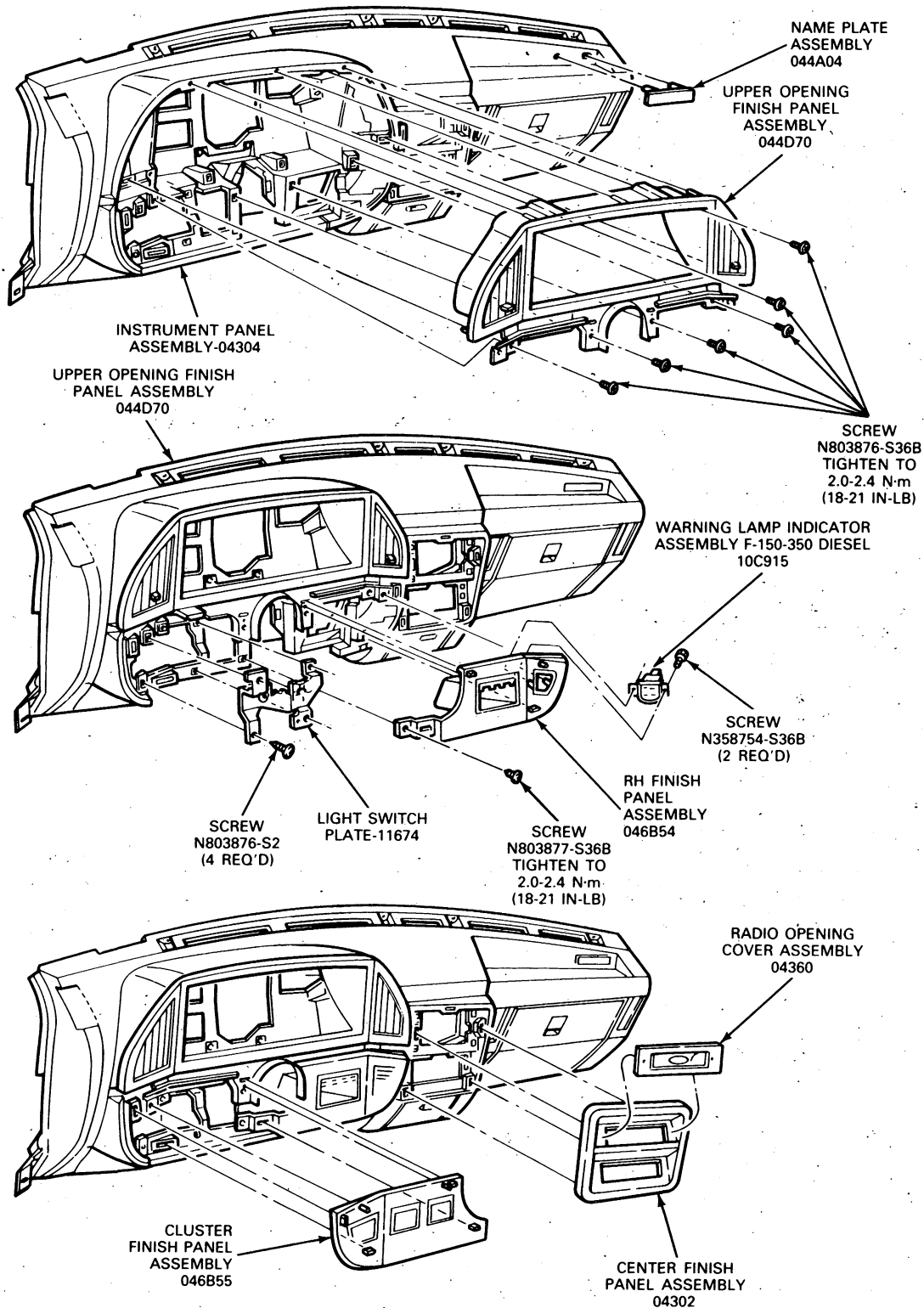


FIG. 6 Instrument Cluster and Cover Installation—F-150—F-350—F-Super Duty and Bronco



R5324-2A

FIG. 7 Cluster Opening Finish Panels—F-150—F-350—F-Super Duty and Bronco

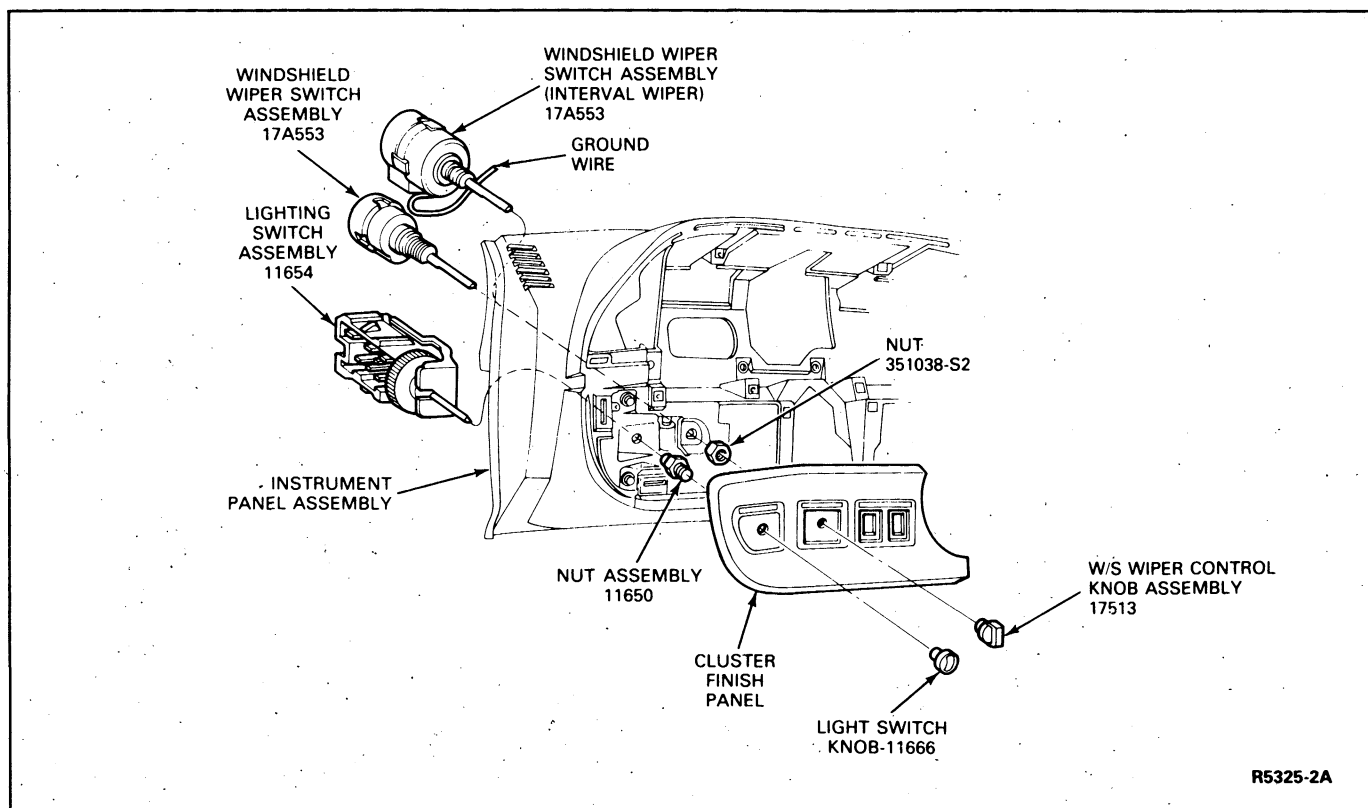


FIG. 8 Light and Windshield Wiper Switch Installation—F-150—F-350—F-Super Duty and Bronco

# TOPS AND EXTERIOR FINISHES

## GROUP 46

(70000)

SECTION TITLE	PAGE	SECTION TITLE	PAGE
FIBERGLASS REAR ROOF .....	46-51-1	TAPE STRIPING .....	46-30-1

## SECTION 46-30 Tape Striping

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION .....	46-30-1	SPECIAL SERVICE TOOLS .....	46-30-3
REMOVAL AND INSTALLATION .....	46-30-1	VEHICLE APPLICATION .....	46-30-1
REPAIR .....	46-30-1		

### VEHICLE APPLICATION

All Models.

### DESCRIPTION

Tape stripes are made from a tough, durable, weather-resistant, solid vinyl with a pressure-sensitive adhesive back. The pressure-sensitive adhesive back is protected by a liner paper which is easily peeled away during installation. During shipment and storage, the face is protected with an easy release pre-mask paper.

### REPAIR

Repair small nicks or scratches using touch-up paints mixed to blend with the affected area.

Repair blisters or air bubbles by piercing them with a sharp needle or pin at one end. Work the trapped air out through the pin hole with the thumb moving toward the pin hole (Fig. 1) and press the tape stripe firmly against the panel. It may be necessary to preheat the panel slightly to soften the adhesive. Heat also may be used to remove small wrinkles or irregularities. If bunching occurs around curves, spread bunching over as large an area as possible, then remove wrinkles.

### REMOVAL AND INSTALLATION

#### Removal

1. Clean repair surfaces, adjacent panels, and openings as required.

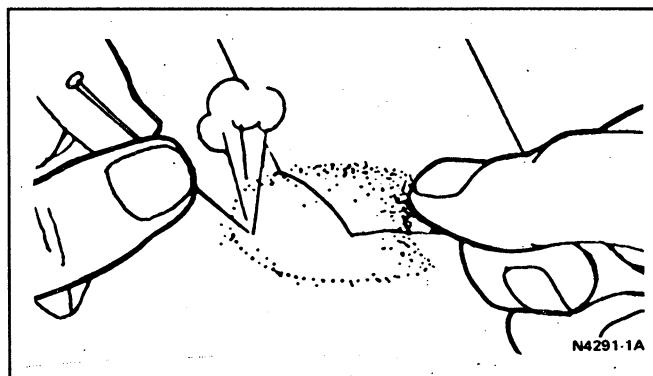


FIG. 1 Removing Entrapped Air

2. Remove any parts overlapping tape stripe from affected panel(s).
3. Remove tape stripe by starting at one edge and peeling it from painted surface. Apply heat to tape stripe to facilitate removal.

NOTE: Removal can also be assisted by using 3M® Woodgrain and Stripe Remover 08907 or equivalent. Avoid using pointed or sharp tools as they may damage the painted surface.

4. Remove adhesive from painted surfaces using a cloth saturated with 3M® Adhesive Remover 08908 or equivalent. Then, scrape with a squeegee.

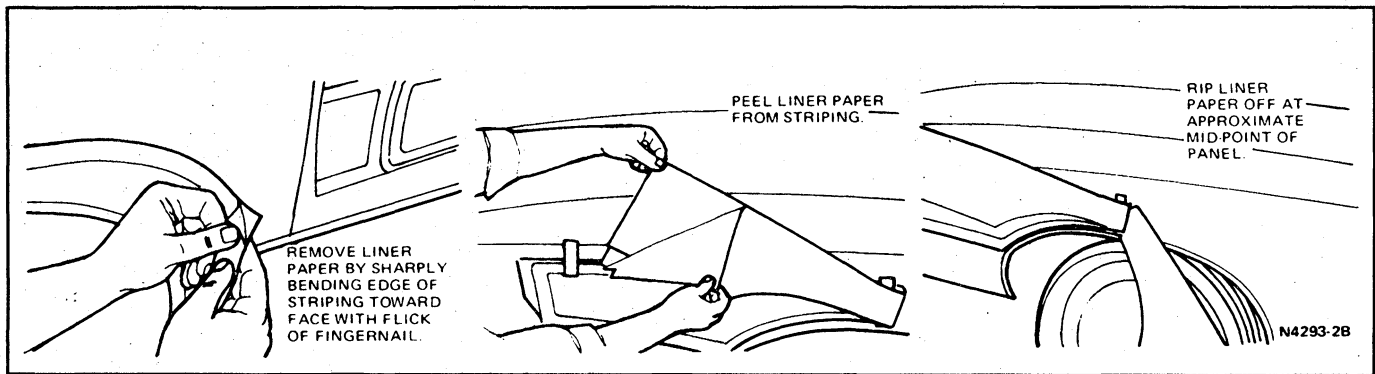


FIG. 2 Removing Liner Paper from Tape Stripe

NOTE: Exercise care when using solvents to avoid possible damage to painted surfaces. To determine if solvent is harmful to body paint, test it on a hidden area of the vehicle.

5. Rinse thoroughly with clean water and/or solvent as required.

#### Installation—Dry Method (Small or Thin Stripes)

1. Clean painted surface (including wrap-around flanges on door openings) with Silicone and Wax Remover DL60-3271-A or equivalent. Wipe surface with a clean cloth and allow to dry.

NOTE: Freshly painted surfaces must be thoroughly dry. Residual solvents in fresh paint may cause tape stripe to blister.

2. Position carrier edge or locating darts on tape stripe to body opening character lines on vehicle. Leading edge of tape stripe has a 2.5mm (1/10-inch) tape and liner extension. The rear edge has no extension. This will help determine which edge is forward and which edge is rearward. Using masking tape, tape striping into place. Use particular care when matching tape stripe to character lines.

NOTE: If tape stripe overlaps occur, ensure forward piece overlaps rear piece.

3. Remove liner paper from stripe at the approximate mid-point panel, and tear off liner paper (Fig. 2).
4. Stretch striping into desired location but away from the sheet metal. Using squeegee (plastic), start from center of panel and press striping into position moving toward the end of the panel (Fig. 3).

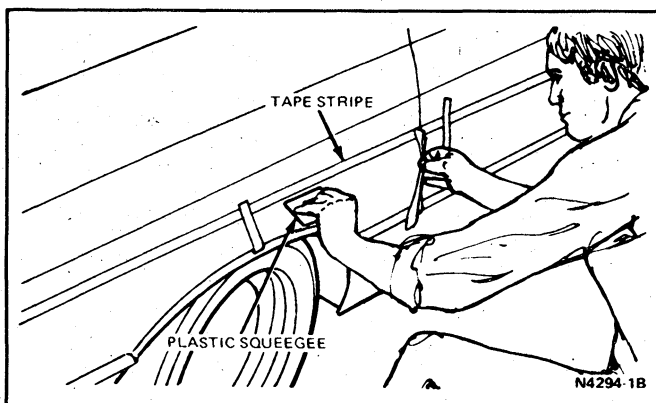


FIG. 3 Installing Tape Stripe with Squeegee

**CAUTION: Do not use hands or fingers to smooth out the striping. Use of hands will result in creases and air bubbles in striping.**

5. Peel off the remainder of liner paper and press striping into position using plastic squeegee.

NOTE: A 3M® SA-3 Low Friction Sleeve or equivalent should be placed over squeegee when installing large letters to prevent stretching and distortion of applique.

6. Remove pre-mask by pulling at 180-degree angle (knuckles against body panel) away from stripe (Fig. 4). After removal of pre-mask, inspect for bubbles. Remove bubbles as outlined.
7. Mold recessed areas into place using Rotunda Heat Gun 107-00301 or equivalent and a soft, clean cloth (Fig. 5).

#### Installation—Wet Method (Large Areas—Decal)

1. Mix a teaspoon of standard dish washing detergent in four liters (one gallon) of water. Fill a spray bottle with the solution.
2. Remove liner paper from tape stripe as outlined in Step 3 of Dry Method Installation, or as required.
3. Wet pressure-sensitive side of tape stripe and panel to be striped with detergent solution.
4. Position tape stripe on vehicle as outlined in Step 2 of Dry Method Installation.
5. Using squeegee and firm overlapping pressure, begin from center of tape stripe and squeegee toward the sides and then toward the front (Fig. 3). The tape stripe can be easily lifted and reapplied if air bubbles are present.

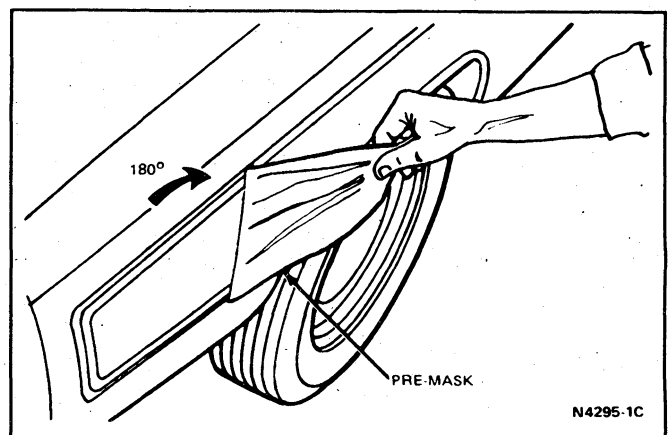


FIG. 4 Removing Pre-Mask Paper

6. After the tape stripe is fully installed and squeegeed, remove pre-mask (Fig. 4). An assistant can be very helpful in removing pre-mask from large areas. Wetting pre-mask on large decals may facilitate removal.
7. Use Rotunda Heat Gun 107-00301 or equivalent as in Dry Method Installation, to mold decal into recessed areas and dry moisture as required. (Fig. 5).

## SPECIAL SERVICE TOOLS

### ROTUNDA EQUIPMENT

Model	Description
107-00301	Heat Gun

CR5236-1B

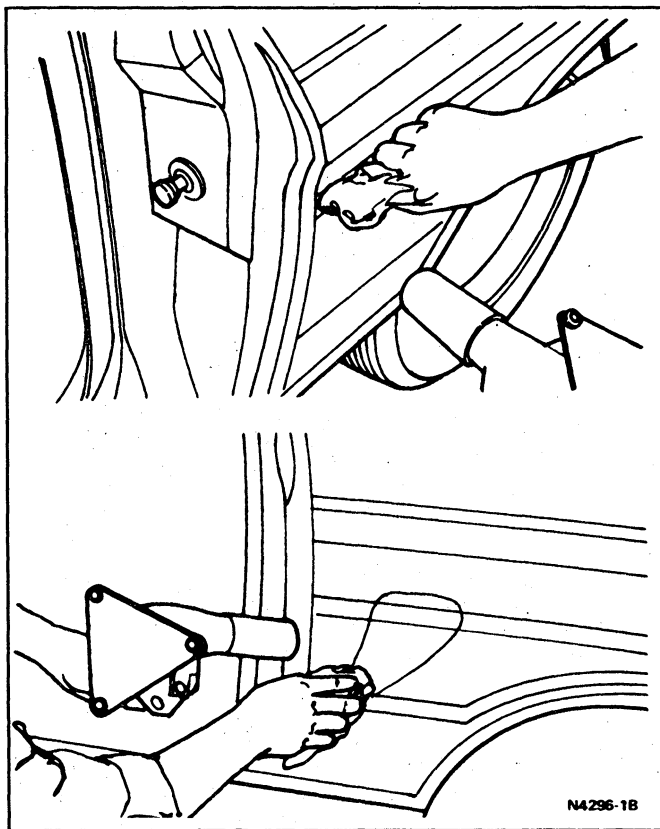


FIG. 5 Molding Striping into Recessed Area

# SECTION 46-51 Fiberglass Rear Roof

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Fiberglass Laminate Repair .....	46-51-1	Trim Moulding Storage (High Series Bronco Only) .....	46-51-3
Fiberglass Roof .....	46-51-3	Weatherstrip Replacement on Roof .....	46-51-1
Fiberglass Roof Repair .....	46-51-1	<b>SPECIAL SERVICE TOOLS</b> .....	46-51-3
Fiberglass Roof Storage .....	46-51-3	<b>VEHICLE APPLICATION</b> .....	46-51-1
Stationary Side Window .....	46-51-1		
Tailgate Glass Care .....	46-51-3		

## VEHICLE APPLICATION

Bronco Vehicles.

## REMOVAL AND INSTALLATION

### Weatherstrip Replacement on Roof

To repair or replace the weatherstrips, remove the roof panel assembly as outlined. Rest the roof in an upside down position on the floor, then proceed to service the weatherstrips as shown in Fig. 1.

### Stationary Side Window

When removing or replacing the glass, an assistant must be employed to work outside the vehicle.

#### Removal

1. Working from inside, start at one corner and work across the top of the glass, pulling the weatherstrip down and pushing the glass and weatherstrip outward until the assistant can grasp the glass and lift it from the glass opening.
2. Remove mouldings, if so equipped.
3. Remove the weatherstrip from the glass (Fig. 2).

#### Installation

1. Clean the weatherstrip with a suitable solvent to remove all old sealer and cement.
2. Clean the glass opening flange. Check the flange for wavy areas, and repair as necessary.
3. Apply Liquid Butyl Sealer C9AZ-19554-B (ESB-M4G162-A) or equivalent in the glass crevice of the weatherstrip and install it onto the glass.
4. Replace mouldings.
5. Run a bead of sealer around the opening flange and in the inner flange crevice of the weatherstrip.
6. Install a draw cord all around the weatherstrip in the flange crevice. Let the draw cords overlap in both mitered corners (Fig. 3). Apply soapy water to the weatherstrip lip.
7. Have an assistant position the window assembly in the window opening and apply hand pressure on the glass. From the inside, draw the lip of the weatherstrip over the window opening lower flange with a draw cord. Start at both mitered corners using both cords at same time. Alternate from side to side, moving approximately 305mm (12 inches) at a time, until the window is in place.

8. Water test the installation for leaks, and apply with additional sealer if necessary.

## Fiberglass Roof Repair

### Surface Preparation

1. Clean the affected area with a Silicone and Wax Remover and inspect the area closely to determine the exact extent of the damage.
2. Using a burr bit on a power drill, form a V-groove the length of the scratch or gouge. The sides of the "V" should be angled no more than 45 degrees.  
  
NOTE: Exercise care to avoid cutting all the way through the laminate during routing operations.
3. Remove all flaky edges and feather the painted surface back approximately 13mm (1/2 inch) beyond the damaged area by hand-sanding or power-sanding with 360-grit sandpaper.
4. Clean the repair area with dry, oil-free, high-velocity compressed air.

### Fiberglass Laminate Repair

1. Following the instructions in the fiberglass repair kit, mix enough filler material on a clean hard surface to re-establish the laminate surface.
2. Just prior to application of the filler material, preheat the repair area using a 375-watt lamp placed 254mm (10 inches) from the repair surface until it is hot to the touch.
3. Using a plastic squeegee, spatula or putty knife, apply and spread the filler material into the repair area, rolling it into the depression and over the surface to avoid excessive air entrapment. Apply sufficient filler material so that the applied repair surface is at least 1.6mm (1/16 inch) above the adjacent laminate surface.
4. Let the filler set up until it is firm to the touch. Then, re-establish the original contour by filing off the excess, leaving the filler level slightly higher than that of the original surface.
5. Pre-shrink the filler, using a Rotunda Heat Gun 107-00301 or heat lamp. A minimum temperature of 48.9°C (120°F) is required for shrinkage.  
  
NOTE: Keep the heat source at least 305mm (12 inches) away from the repair area.
6. Power-sand the filler with 360-grit sandpaper until it is smooth and even with the original surface. If the



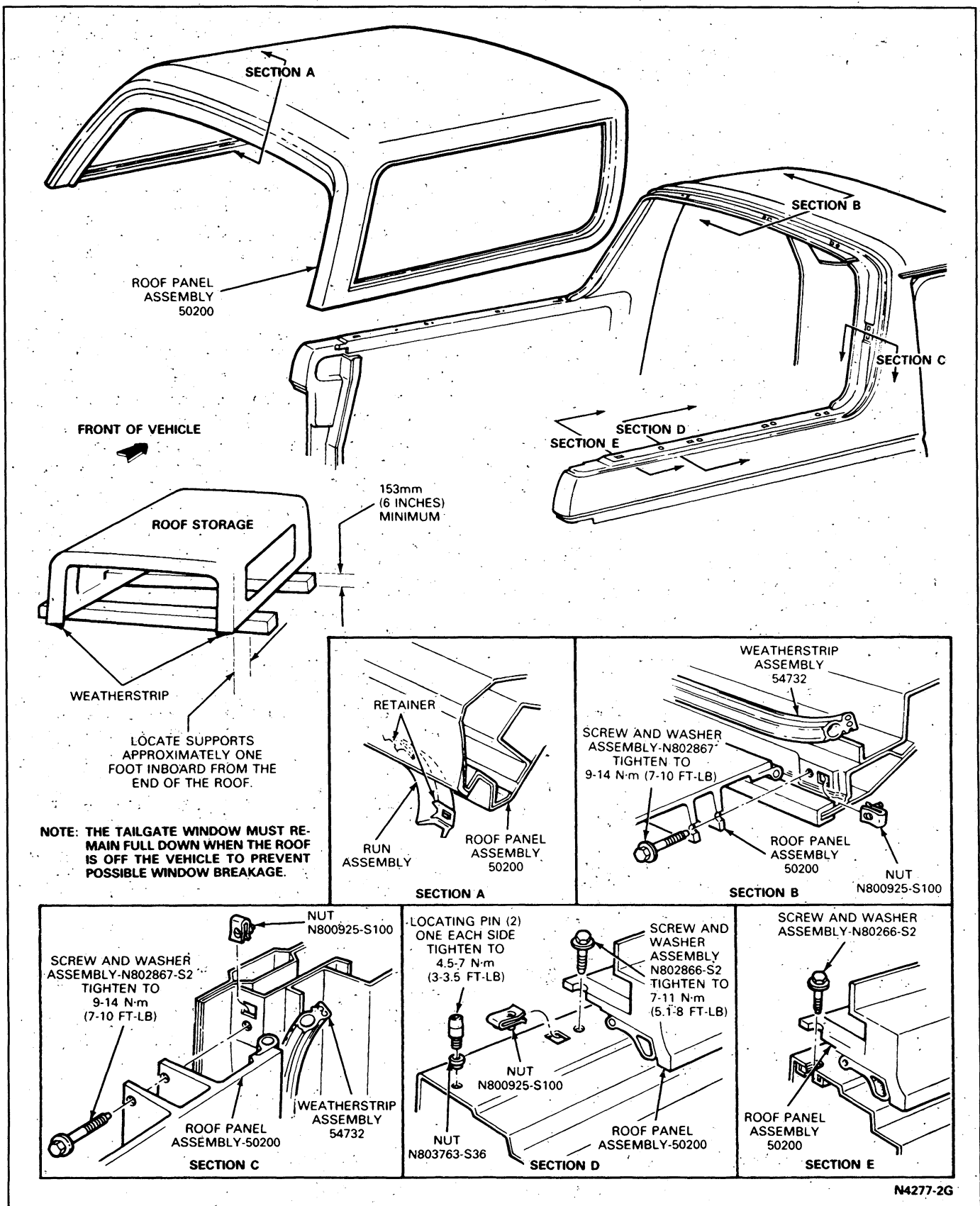


FIG. 1 Fiberglass Roof Removal and Installation

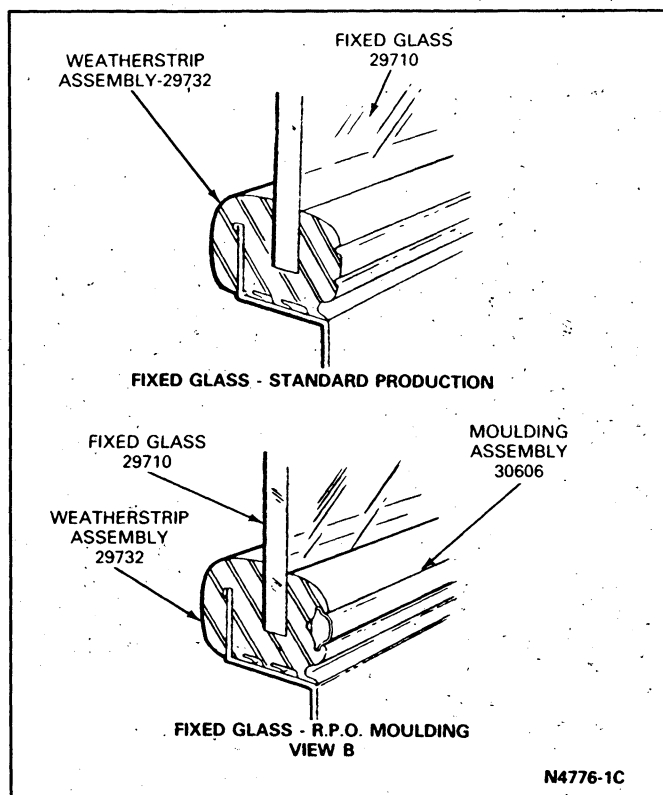


FIG. 2 Window Removal and Replacement

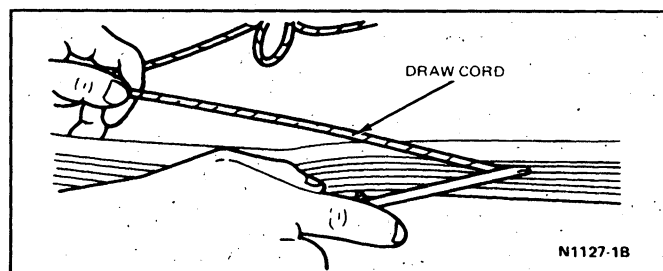


FIG. 3 Draw Cord Installed—Typical

filler surface exhibits fine pinholes, apply a thin coat of glaze wipe or equivalent. If the filler is pockmarked, do not use the glaze wipe. Instead, apply another layer of filler, repeating Steps 1 through 6.

7. Finish by sanding with a sanding block and 400-grit sandpaper.
8. Clean the repair area with dry, oil-free, high-velocity compressed air.
9. Repair the paint (Spatter Texture Coat) using the appropriate painting procedure.

## Fiberglass Roof

### Removal

1. Lower the tailgate window to the full down position.
2. Lower tailgate.
3. Remove the lower trim moulding attaching screws and the plastic trim mouldings. Scribe the location

of the moulding attaching brackets on the fiberglass roof's surface and number each bracket as it is removed for reference during installation.

4. Remove all the roof attaching bolts and moulding attaching brackets (Fig. 1).
5. Carefully lift the roof off the vehicle to prevent tearing or separating the weatherstrip from the fiberglass roof. The roof weighs 264 kg (120 lb).
6. Remove the two fiberglass roof locating pins (Fig. 1).

NOTE: The tailgate window must always remain in the full down position when the roof is off the vehicle to prevent possible window breakage.

### Installation

1. Install the two fiberglass roof locating pins (Fig. 1). Ensure the tailgate window is in the full down position. Ensure that the tailgate is down.
2. Carefully place the roof on the vehicle, lining up the two locating pins.
3. Loosely install all moulding attaching brackets and roof attaching bolts, ensure that the brackets are located in their original positions.
4. Install the upper roof fasteners (Fig. 1). Install remaining roof fasteners (Fig. 1). Fasteners should be tightened enough to compress weatherstrip without distorting roof.
5. Install the plastic trim mouldings and attaching screws. Using caution not to crack the mouldings, tighten the screws securely.

### Fiberglass Roof Storage

To prevent permanent deformation to the portion of the belt weatherstrip extending below the lower edge at the rear of the fiberglass roof, store the removed roof right side up on a level surface at least 152mm (6 inches) above the ground (Fig. 1).

### Trim Moulding Storage (High Series Bronco Only)

In order to protect the plastic trim mouldings from damage during storage, it is recommended they be placed inside the removed fiberglass roof.

### Tailgate Glass Care

When operating the vehicle in an extremely dusty environment, the tailgate glass should be cleaned periodically with Ultra Clear Spray Glass Cleaner E4AZ-19C507-A (ESR-M14P5-A) or equivalent to prevent buildup of surface dust. This will ensure the best possible performance and the greatest number of years of trouble-free service.

### SPECIAL SERVICE TOOLS

#### ROTUNDA EQUIPMENT

Model	Description
107-00301	Heat Gun

CR5236-1B

# BODY SHELL, EXTERIOR TRIM, FRAME AND UNDERBODY

GROUP  
**47**  
(70000)

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BODY TRIM AND MOUNTING—ECONOLINE .....	47-52-1		

## SECTION 47-01 Body Shell, Exterior Trim, Frame and Underbody—General Service

SUBJECT	PAGE	SUBJECT	PAGE
<b>ADJUSTMENTS</b>		<b>GENERAL INFORMATION (Cont'd)</b>	
Checking Body For Misalignment .....	47-01-3	Type Of Sealers and Application (Cont'd)	
Diagonal or X Frame Checking		Liquid Butyl Sealer—C9AZ-19554-B (Black) or Equivalent .....	47-01-2
Method .....	47-01-3	Rubber Cement—8A-19552-B, or Equivalent .....	47-01-2
Frame Inspection .....	47-01-3	<b>REPAIR OPERATIONS</b>	
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Body Maintenance .....	47-01-5	Painting .....	47-01-4
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Rattle Elimination .....	47-01-2	Weld Attachment .....	47-01-4
Wind Noise .....	47-01-2	Welding Precautions .....	47-01-3
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Type Of Sealers and Application .....	47-01-2	<b>VEHICLE APPLICATION</b> .....	47-01-1
Caulking Cord—D6AZ-19560-A, or Equivalent .....	47-01-2		

### VEHICLE APPLICATION

E-150—E350, F-150—F-350, F-Super Duty and Bronco.

## GENERAL INFORMATION

### Type Of Sealers and Application

Since many sealers are used in vehicle assembly, the following all-purpose sealers have been selected for service use. The method and points of application are shown in each applicable group.

#### Caulking Cord—D6AZ-19560-A, or Equivalent

This sealer has a plastic base with a filler, is heavy bodied and is commonly known as perma-gum. It is used on spotweld holes, around mounting clips, and between two surfaces not sealed by a gasket. Apply the sealer with a putty knife.

NOTE: Meets Ford Specification ESB-M4G32-A.

#### Rubber Cement—8A-19552-B, or Equivalent

This quick-drying, strong, adhesive cement is designed to cement weatherstripping to doors, bodies, cowl ventilators, and the surrounding metal. Windows and windshields that are set in rubber can be effectively sealed against leakage by flowing cement into affected areas.

Clean all grease, dirt, and old sealer from the surfaces to be cemented. Wash the surfaces thoroughly with a cloth moistened with a suitable commercial cleaner. For best results, apply a medium coat of cement to both surfaces, allow it to dry until tacky, and then press both surfaces firmly together.

NOTE: Meets Ford Specification ESR-M11P16-A.

#### Liquid Butyl Sealer—C9AZ-19554-B (Black) or Equivalent

This sealer does not run, is fast drying, and remains semi-elastic. The sealer can be used for seam sealing in such areas as the floorpan, wheelhouse, dash panel, running board, door openings and drip rails. It can also be used to seal outside moulding clip holes, and for windshield and back window installation.

NOTE: Meets Ford Specification ESB-M4G162-A.

## DIAGNOSIS AND TESTING

### Dust and Water Leaks

Remember, the forward motion of the vehicle creates a slight vacuum within the body, particularly if a window or ventilator is partially open. Any unsealed crevice or small opening in the lower section of the body will permit air to be drawn into the body. If dust is present in the air, it will follow.

Under certain conditions, water can enter the body at any point where dirt or dust can enter. Any consideration of water leakage must take into account all points covered under dust leaks.

To determine the exact location of a dust leak, remove the following trim from the cab: the cowl trim panel, the kick pads, and the floor mats.

Removal of the trim will reveal the location of most leaks. Seal these leaks, and road test the vehicle on a dusty road to ensure all leaks are sealed. The entrance of dust is usually indicated by a pointed shaft of dust or silt at the point of entrance. After the road test, check for indications of a dust pattern around the door openings, cowl panel, and cowl side panel.

Sometimes leaks can be located by putting bright lights under the vehicle with the above components

removed, and checking the interior of the body at joints and weld lines. The light will show through where leaks exist.

### Floorpan Plugs and Grommets

Many plugs and grommets are used in the floorpan and dash panel. The floorpan plugs seal the various body bolt access holes.

If any plugs are missing or damaged, a dust or water leak may result. Such leakage may also occur around grommets used on the dash panel. When dust or water leaks are evident, these plugs and grommets should be checked for proper installation.

### Drain Holes

Drain holes are located on the underside of each door along the weld line of the inner and outer panels. If these holes become clogged with mud or road tars, water will collect inside the panels and rust the sheet metal from the inside. A sound of sloshing water in a door is an indication of this condition.

**Check the drain holes regularly. Clean the drain holes of dirt and foreign material with a punch or screwdriver.**

### Wind Noise

Air entering or exiting the vehicle through small openings in the body can result in wind noise. Sources of wind noise are detected by driving the vehicle at highway speeds in four different directions. Listen for sources of wind noise with all windows closed, radio off, heater and air conditioner blower motor turned off and ventilation ducts open. A stethoscope can be used to pinpoint the source of the noise.

Most wind noise-producing leaks will occur at the door and window seals or at sheet metal joints in the door or the door opening in the body.

Seal all leaks with RTV sealant and foam tape or by positioning or replacing the seals. Road test the vehicle to ensure all leaks have been adequately sealed.

An alternate method of verifying corrective actions involves the use of Rotunda Ultrasonic Leak Detector 029-00001 or equivalent. After identifying the leak point through a drive evaluation, obtain a meter reading by using the leak detector. A check with the leak detector after repairing the leak will verify the effectiveness of the corrective action. A final test drive may still be advisable to ensure that other objectionable leaks, not noticed because of a major leak, do not exist.

### Rattle Elimination

**Most** rattles are caused by loose foreign objects such as nuts, screws, bolts or small pieces of body deadener in the door wells, pillars, and quarter panels. Door wells can be checked by carefully striking the underside of the door with a rubber mallet. The impact made by the mallet will indicate if loose objects are in the door well.

**All body bolts and screws should be tightened periodically.** In the event that tightening the bolts and screws located on such assemblies as the doors does not eliminate the rattles, the trouble is probably caused by **misalignment**. If this is the case, follow the adjustment and alignment procedures for these assemblies.

Rattles and squeaks are sometimes caused by weatherstripping and anti-squeak material that has slipped out of position. Apply additional cement or other

adhesive, and install the material in the proper location to eliminate this difficulty.

## ADJUSTMENTS

### Checking Body For Misalignment

To align or square up a body, take two opposite diagonal measurements between pillars. Use a measuring tram for these measurements. Take the measurements between reference points such as crease lines or weld joints which are diagonally opposite each other on the two pillars being measured. Since all measurements should be made from the bare metal, remove all interior trim from the checking points.

In some cases, it is difficult to obtain proper body alignment when repairing a body that is damaged on both sides. In these cases, horizontal and vertical measurements can be taken from a body of the same body style. Once these basic dimensions are taken and established on the damaged body, alignment can be made by diagonal measurements taken from points on the two pillars.

Do not attempt to correct any serious misalignment with one jacking operation. This is particularly true if other sections of the body also require aligning. Align each section proportionately until the proper dimensions are obtained.

Door openings are checked in the same manner as the body. Horizontal, vertical, and diagonal checking points are established on all four sides of the door opening that is being measured.

### Frame Inspection

Frame misalignment is the result of damaged frame components.

Before checking frame alignment, inspect all frame members for damage, for cracks, twists, or bends. Check all welded connections for cracks. Inspect all rivets, bolts, and body support brackets for looseness. Make all necessary repairs or replacements.

### Diagonal or X Frame Checking Method

Frame alignment can be checked without removing the body from the frame by using the diagonal or X checking method.

This method should be used to identify misalignment prior to any attempt to straighten a frame.

1. Place the vehicle on a clean level floor and set the parking brake.
2. Select at least four points along one frame side member and transfer these points to the floor with a plumb bob. If desired, paper can be taped on the floor along both sides of the vehicle below the frame. Mark the points on the floor as accurately as possible.
3. Locate the corresponding points along the opposite frame side member and transfer these points to the floor in the same manner.
4. Move the vehicle away from the marks on the floor, and measure diagonally between all points on the floor. Both measurements should be equal within 6.35mm (1/4 inch).
5. Measure between corresponding points parallel to the frame side members. These measurements should be within 3.18mm (1/8 inch) of each other.

The squareness of the frame side member web to the floor at the spring hangers and at the steering gear mounting location should be within 1.59mm (1/16 inch). The squareness of the frame side member web to the floor at all other points should be within 3.18mm (1/8 inch). The web and flange should be square at all other points within 3.18mm (1/8 inch).

Any point on one side member should be within 3.18mm (1/8 inch) ahead, behind, above, or below the corresponding point on the opposite side member. The frame side member should not be bowed more than 3.18mm (1/8 inch) for each 2540mm (100 inches) of frame length. The overall width of the frame should not vary more than 3.18mm (1/8 inch).

NOTE: An alternate method of checking frame alignment is to use a frame gauge.

## REPAIR OPERATIONS

### Frame Repair

#### Drilling Precautions

**Do not drill holes in the frame flanges, since this tends to reduce the frame strength.**

If a hole must be drilled in the frame, insure that it meets all the following requirements:

1. The hole is located in the upper half of the frame.
2. The edge of the drilled hole and the edge of the nearest hole are at least 25mm (1 inch) apart.
3. The edge of the drilled hole is at least 25mm (1 inch) from the edge of the flange.
4. The drilled hole is not adjacent to any other existing frame brackets or components.

#### Welding Precautions

Disconnect the negative battery ground cable before using electric welding equipment.

All frame welding **must** be done with electric welding equipment, and the heat should be kept in a small area to prevent change in hardness of the metal. **Do not use gas welding equipment. A double reinforcement must be added to frames where heat or weld is applied to the area to be repaired. The welds are to run lengthwise along the reinforcement when a reinforcement is to be welded to a side member.**

### Frame Straightening

Frame misalignment can be corrected by straightening the out-of-line parts or by replacing the crossmembers, braces, or brackets if they are badly damaged.

Straightening should be attempted on frames that fail to meet specifications of the diagonal checking method or where damage is visually apparent.

However, to prevent internal stresses in the metal, frame straightening should be limited to parts which are not severely bent. **If heat is needed to straighten a frame member, keep the temperature below 649°C (1200°F) (a dull red glow). Excessive heat may weaken the metal in the frame members and cause permanent damage.**

### Frame Reinforcing

After a bent frame member has been straightened, inspect the member closely for cracks. If any cracks

show, the frame member should be reinforced or replaced.

Reinforcements should be made from angle or flat stock of the same material and thickness as the frame member being reinforced, and should extend a minimum of 152.40mm (6 inches) to either side of the crack. Ideally, the reinforcement should be cut from the corresponding area of a similar frame.

### Weld Attachment

The following procedure must be adhered to if it is deemed necessary to weld reinforcements to the frame and to ensure quality repair.

The crack should be prepared before welding the reinforcement to the cracked frame member by wire brushing the area around the crack to remove the paint, grease, mud, etc. to completely expose the crack and assure good weld adhesion. To stop the crack from spreading, drill a 6.35mm (1/4-inch) hole at a point 12mm (0.50 inch) beyond the root of the crack. Grind out the full length of the crack to the hole to form a V-shaped slot with the base of the "V" contacting the reinforcement. The base of the "V" should have at least 1.52mm (.06 inch) opening to insure weld penetration to the reinforcement when welding the crack. Drill clearance holes in the reinforcements, to clear rivet heads and bolt heads or nuts where necessary.

In the event that repair is required to more than one frame surface (i.e., a flange crack which extends into the web) two pieces of flat stock (one for each surface) should be utilized and welded together where they join (Fig. 1). The web reinforcement should be a minimum 76.20mm (3.0 inch) high and have 63.50mm (2.5 inch) radius at each of the two corners.

Completely clean the frame surface under and around the reinforcements. Clamp the reinforcements securely to the frame prior to welding. Weld the reinforcement all around after welding the crack "V" to the reinforcement (Fig. 1). The flange edge weld should be ground smooth after all pit holes have been filled by the weld.

If a damaged, bolted on frame bracket is to be replaced, the new bolts, washers, and nuts should be of the same specifications and bolt torques as the original parts.

In cases where it is necessary to remove rivets, replace them with Property Class 9.8 metric (Grade 8) nuts, bolts and washers of the next larger size (i.e., for 3/8 diameter rivets use 7/16-inch bolts, for 7/16 diameter rivets use 1/2-inch bolts). This requires line drilling of the holes to the same diameter as the new bolt (i.e., either 0.437 diameter or 0.500 diameter).

### Frame Member Replacement

If a damaged frame member is to be replaced, new bolts, Property Class 9.8 metric (Grade 8) fasteners, and rivets required for replacement of parts should be of the same specifications as the original bolts or rivets. In cases where it is necessary to substitute a bolt for a rivet, use the next larger size bolt.

### Fiberglass Repair

#### Safety Precautions

Always use rubber gloves or the special hand cream supplied with epoxy resin repair kits. **REMOVE ANY RESIN FROM HANDS AS SOON AS POSSIBLE AND**

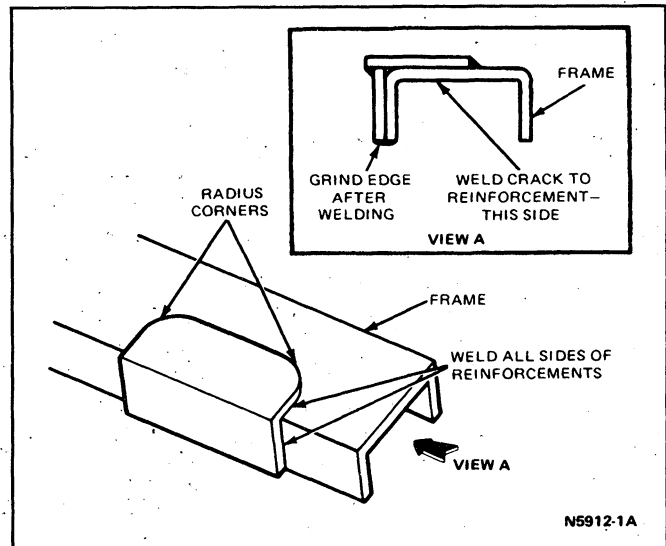


FIG. 1 Weld Attachment of Frame Reinforcement—Two Frame Surfaces

**PARTICULARLY BEFORE THE MIXTURE STARTS TO GEL.** Any resin that adheres to the hands may be removed with lacquer thinner followed by a thorough washing with soap and water.

Use a respirator when grinding the fiberglass surface and use a vacuum attachment when operating a belt sander.

Always work in a well ventilated area in order to avoid possible toxic fumes that may result from using resin mixtures. Exercise care so as not to get any resin on clothing.

Keep all materials, utensils and the work area clean and dry as resin repairs involve chemical reactions. Any dirt, foreign material or moisture may upset the chemical reaction and result in an unsatisfactory repair.

### Repair Procedure

Grind or sand away all loose or broken material at the damaged area. Scuff sand the surface approximately 25.4mm (1 inch) around the area to provide a good bonding surface. Ensure the surface to be repaired is clean, dry, oil and paint free.

For cracks, form a shallow V-shape along the crack with a file or grinder. Fill the area with a good quality polyester or epoxy body repair compound. Follow the manufacturer's directions with regard to mixing procedures. Allow the compound to harden and then sand smooth. If the surface is not level or smooth, use an additional filling and sand to a final smooth finish.

For larger broken areas use fiberglass cloth (five layers) impregnated with the resin, to cover the area. Overlap the damaged portion by 25.4-50.8mm (1-2 inches). When the material has hardened, file or grind and sand smooth. If low spots exist, fill them with resin mixture to which short fibers cut from the fiberglass cloth have been added. Add enough on the cloth to form a putty-like resin mixture.

### Painting

After the desired repaired surface has been obtained, prime and paint the surface in the normal manner.

## CLEANING AND MAINTENANCE

### Chrome and Bright Metal Care

Many parts of the vehicle, such as the bumpers and body hardware, are chrome-plated or anodized aluminum. These finishes are susceptible to corrosion due to salt air near coastlines (or salt spray during winter), factory smoke and other conditions found in today's cities. When such conditions exist, frequent washing and the use of Custom Bright Metal Cleaner 8A-19522-A or equivalent wax or polish is recommended.

Do not use steel wool, abrasive-type cleaners or strong detergents containing highly alkaline or caustic agents on chrome plated or anodized aluminum parts. These methods or cleaners may damage the protective coating and cause discoloration and/or paint deterioration.

### Vinyl Insert Moulding Care

Rinse the vinyl to remove loose dirt and grime. Exceptionally dirty areas should be pre-cleaned with Extra Strength Whitewall Tire Cleaner E0AZ-19526-BA or Ford Multi-Purpose Cleaner B8A-19523-A diluted to proper concentration per label directions or mild soap solution. Next, apply Ford Vinyl Hardtop Cleaner E3AZ-19F535-A or equivalent following label directions.

Commercial hot waxes applied at automatic car washes have been known to affect cleanability of vinyl material.

**CAUTION—To avoid damage to the vinyl insert mouldings, use only an approved Ford cleaner, or equivalent. The use of stiff bristle brushes or abrasive material or cleaners must be avoided.**

### Bumpers and Trim

The bumpers and trim on the vehicle requires no special care. Periodic cleaning will preserve the beauty and life of these finishes. Wash with clear water or if the parts are very dirty, use Multi-Purpose Cleaner Concentrate B8A-19523-AA or an equivalent compound. Using a clean soft cloth or a sponge and water, rinse and wipe the parts dry. Custom Bright Metal

Cleaner 8A-19522-A or equivalent may be used sparingly to remove rust or salt corrosion from chrome plated parts. Do not scour aluminum- or chrome-finished parts with steel wool or polish them with products containing abrasives. A coating of wax will provide excellent protection for all bright metal parts.

### Body Maintenance

Regular body maintenance preserves the vehicle's appearance and reduces the cost of maintenance during the life of the vehicle. The following steps are suggested as a guide for regular body maintenance:

1. Vacuum the interior thoroughly and wash the vehicle.
2. Check all openings for water leaks, and seal where necessary.
3. Inspect loose weatherstrips for width of channel. Crimp as required to ensure retention to body flange.
4. Replace all door and tailgate weatherstrips which are unfit for service.
5. Replace all cracked, fogged, or chipped glass.
6. Align the hood and doors if necessary.
7. Inspect the windshield wiper blades and replace them if necessary.
8. Tighten the sill plate and garnish moulding screws.
9. Clean the seats, door trim panels, and headlining.
10. Touch up or paint chipped or scratched areas.
11. Periodically clean drain holes located on the underside of each rocker panel, quarter panel, and door.

## SPECIAL SERVICE TOOLS

### ROTUNDA EQUIPMENT

Model	Description
029-00001	Ultrasonic Leak Detector

CN6031-1C

# SECTION 47-30 Body Trim and Mounting—F-Series and Bronco

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
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Bronco .....	47-30-5	GT Bar—Pickup Box Mounted .....	47-30-6
F-150—F-350—Regular, Super Cab and		Inside Spare Wheel Carrier (Bronco) .....	47-30-7
Super Duty Chassis Cab .....	47-30-5	Rear Bumper .....	47-30-7
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Front Bumper .....	47-30-3	Under Frame—F-150—F-350, F-350	
Front Fender .....	47-30-2	Chassis Cab and F-Super Duty Chassis	
Radiator Grille .....	47-30-1	Cab .....	47-30-5
Rear Fender .....	47-30-3	<b>VEHICLE APPLICATION</b> .....	47-30-1

## VEHICLE APPLICATION

F-150 Through F-350, F-Super Duty and Bronco Truck Models.

## REMOVAL AND INSTALLATION

### Radiator Grille

Refer to Fig. 1.

#### Removal

1. Remove two expansion screws retaining grille assembly to headlamp housings.
2. Carefully push in on bottom of four moulded snap-in retainers to disengage from headlamp housings. Remove grille assembly from vehicle.

#### Installation

1. Carefully position radiator grille to headlamp housings making sure moulded snap-in fasteners are aligned with slots in headlamp housings.
2. Using hand-pressure, push corners of grille inward until snap-in barbs of moulded fasteners engage in headlamp housings.
3. Insert plastic expansion screw nuts into grille and headlamp housings. Push expansion screws into plastic nuts until screws are fully seated.

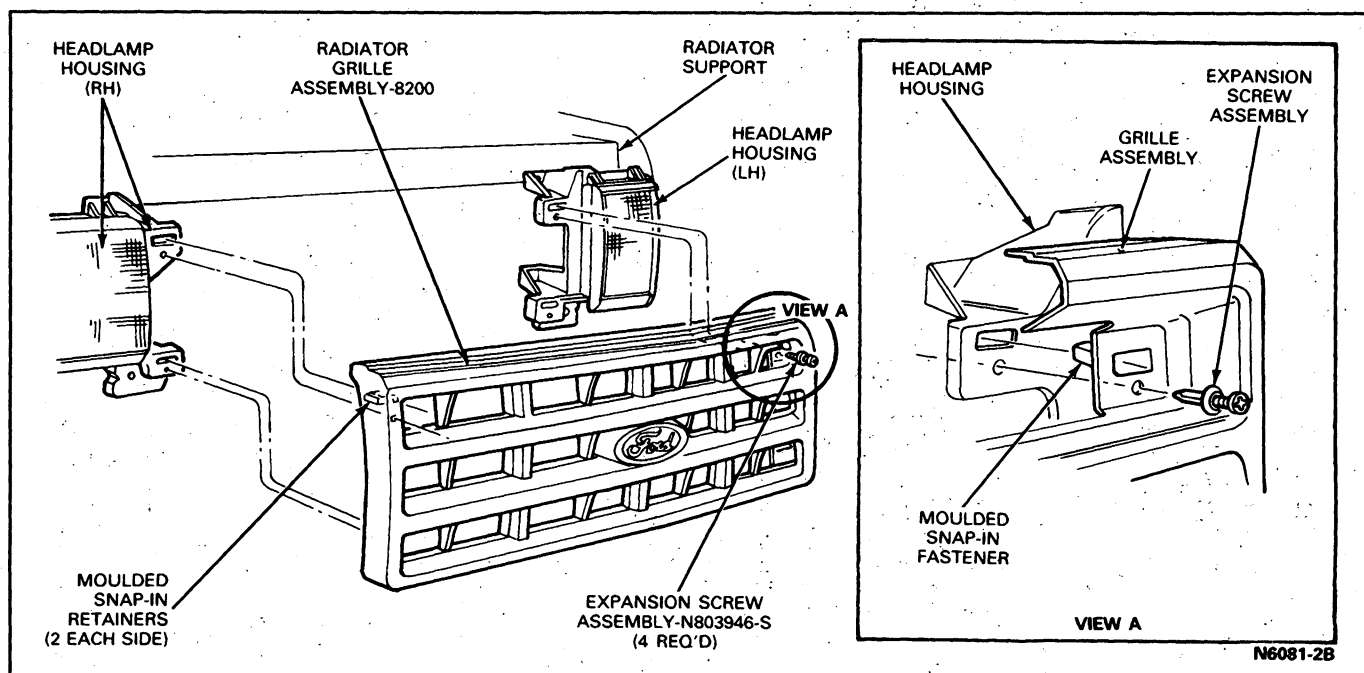


FIG. 1 Radiator Grille—Bronco, F-150—F-350 and F-Super Duty



## Front Fender

### Removal

1. Clean all dirt from the fender attaching screws, bolts and nuts.
2. Remove headlamp assemblies from the vehicle as outlined in Section 32-03, Headlamp System.
3. Remove the screws attaching the front of the fender to the radiator support at upper and lower locations.
4. Remove one screw attaching the rear lower end of the fender to the lower corner of the cab (Fig. 2).
5. Remove one screw from inside the cab attaching the rear lower end of the fender to the cowl.
6. Remove the screws attaching the top edge of the fender at the rear, to the cowl extension.
7. Remove screws around wheel opening attaching the fender apron (Fig. 3).

8. Remove the bolts along top of apron that attach to fender.
9. Remove bolts attaching battery tray to fender (RH only) and bolts attaching auxiliary battery tray or tool box (both R.P.O.) (LH only).
10. Remove hood latch cable from LH fender and main wiring harness from RH fender.
11. Remove the screw attaching the hood prop spring to the fender and remove fender.

### Installation

1. Position the nuts and retainers on the fender.
2. Apply sealer to the upper edge of the apron.
3. Position the fender to the apron and loosely install the screws.
4. Loosely install one screw from the inside of the cab, attaching the rear lower end of the fender to the cowl.

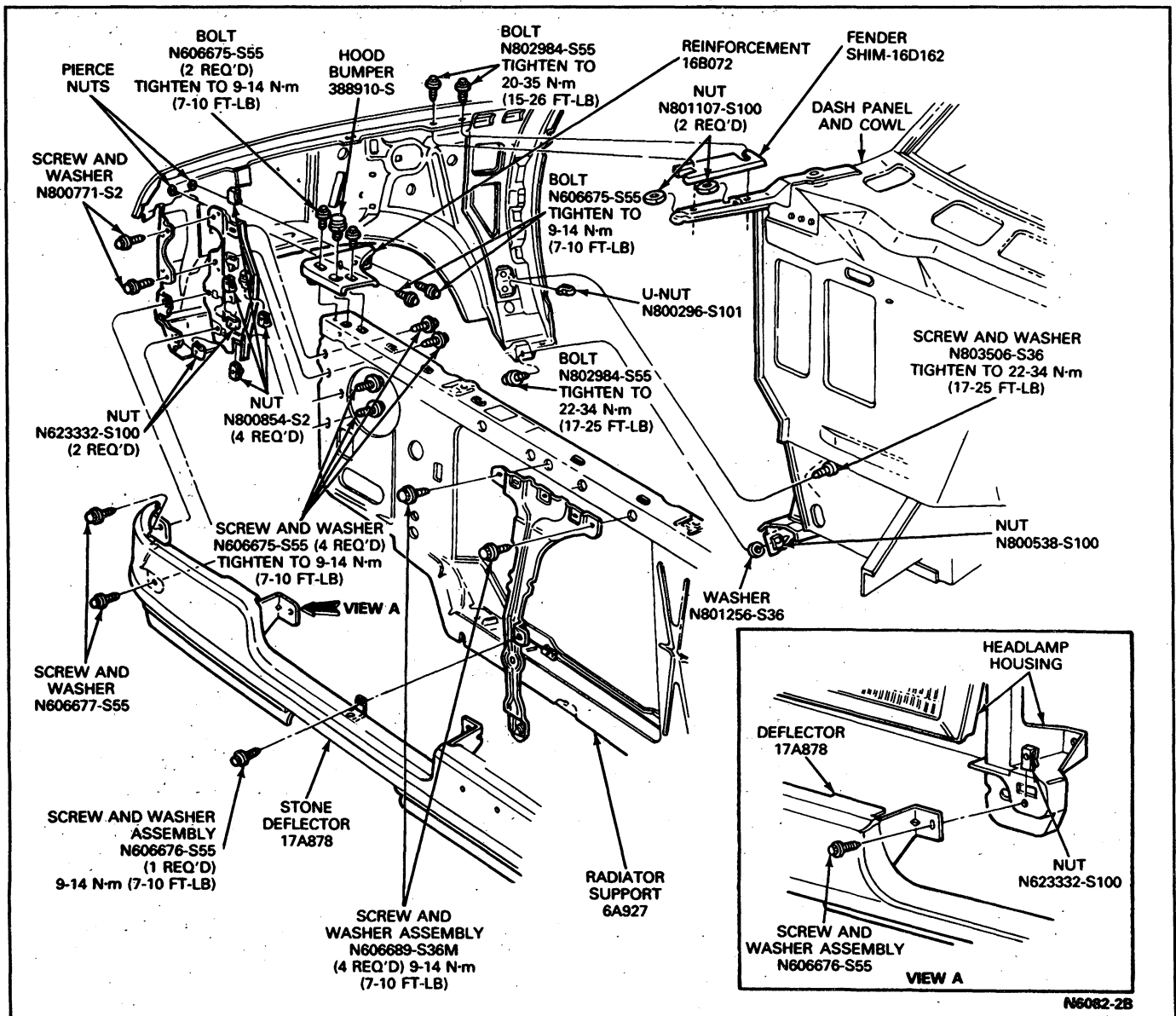


FIG. 2 Front Fender Installation Right Side—F-150—F-350—F-Super Duty and Bronco

- Loosely install a screw, attaching the rear lower end of the fender to the lower corner of the cab.
- Loosely install the screws, attaching the front of the fender to the radiator support.
- Adjust the fender position and tighten all mounting screws.
- Install the hood prop spring to the fender.
- Install headlamp assemblies as outlined in Section 32-03, Headlamp System.

## Rear Fender

### F-350, with Dual Wheels

Refer to Fig. 4.

### Removal and Installation

- Remove two upper and one lower splash shield-to-fender attaching nuts and bolts (Fig. 4).
- Remove front and rear fender brace attaching bolts.
- Remove 11 fender-to-body attaching bolts.

- Support fender and remove two (one each upper corner) fender-to-body retaining nuts. Remove fender.
- To install, reverse Steps 1 through 4. Tighten all attaching nuts and bolts to specifications (Fig. 4).

## Front Bumper

The front bumper installation for all light truck models (except F-Super Duty Stripped Chassis) is shown in Fig. 5.

### Removal

- Remove nuts retaining bumper brackets to frame rails.
- Remove screws from brackets and remove bumper and brackets from vehicle.
- If bumper is to be replaced by a new one, transfer bumper brackets to new bumper.

### Installation

- Position bumper and brackets to frame rails.

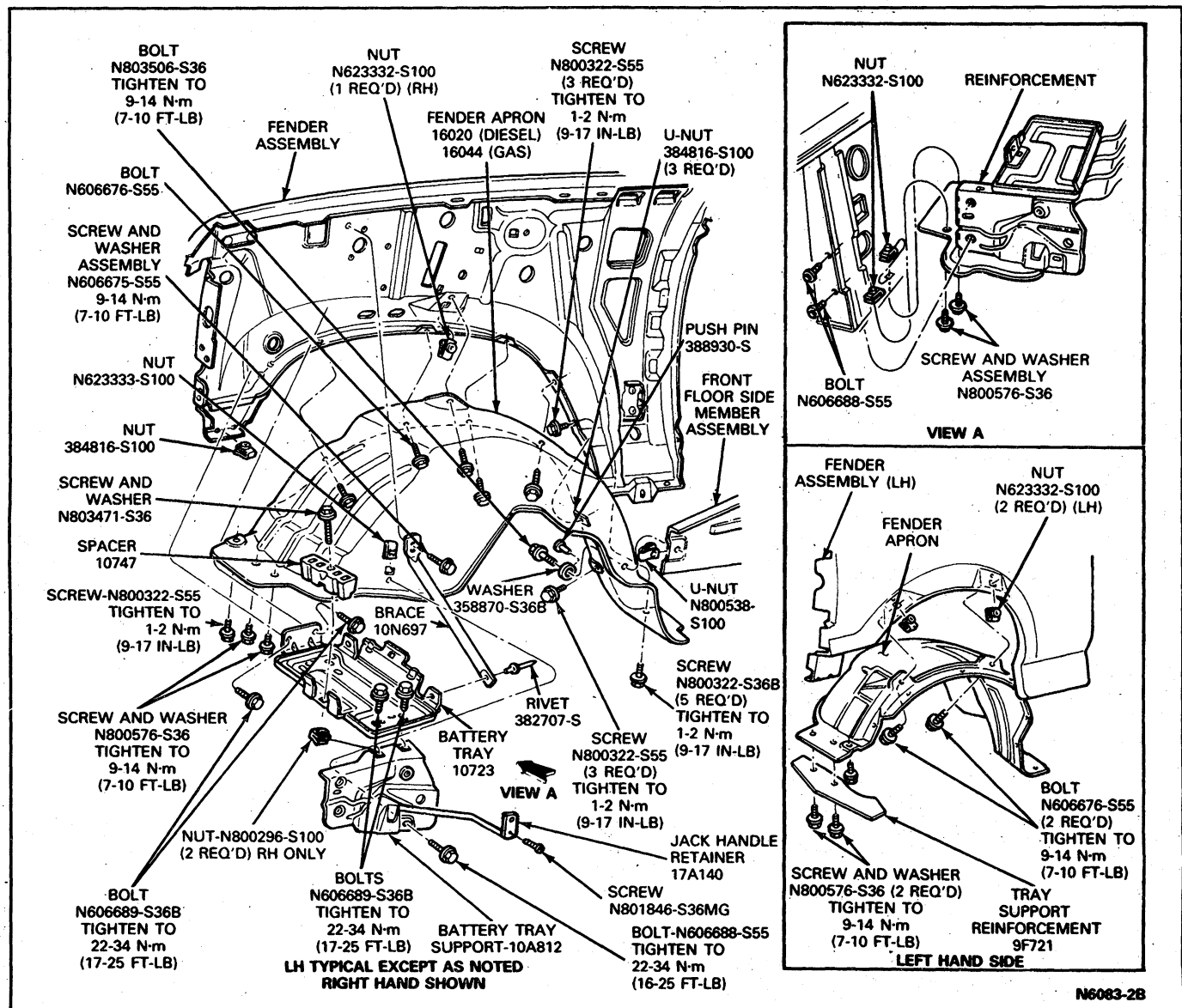


FIG. 3 Fender Apron Installation, Right Side—F-150—F-350 and Bronco

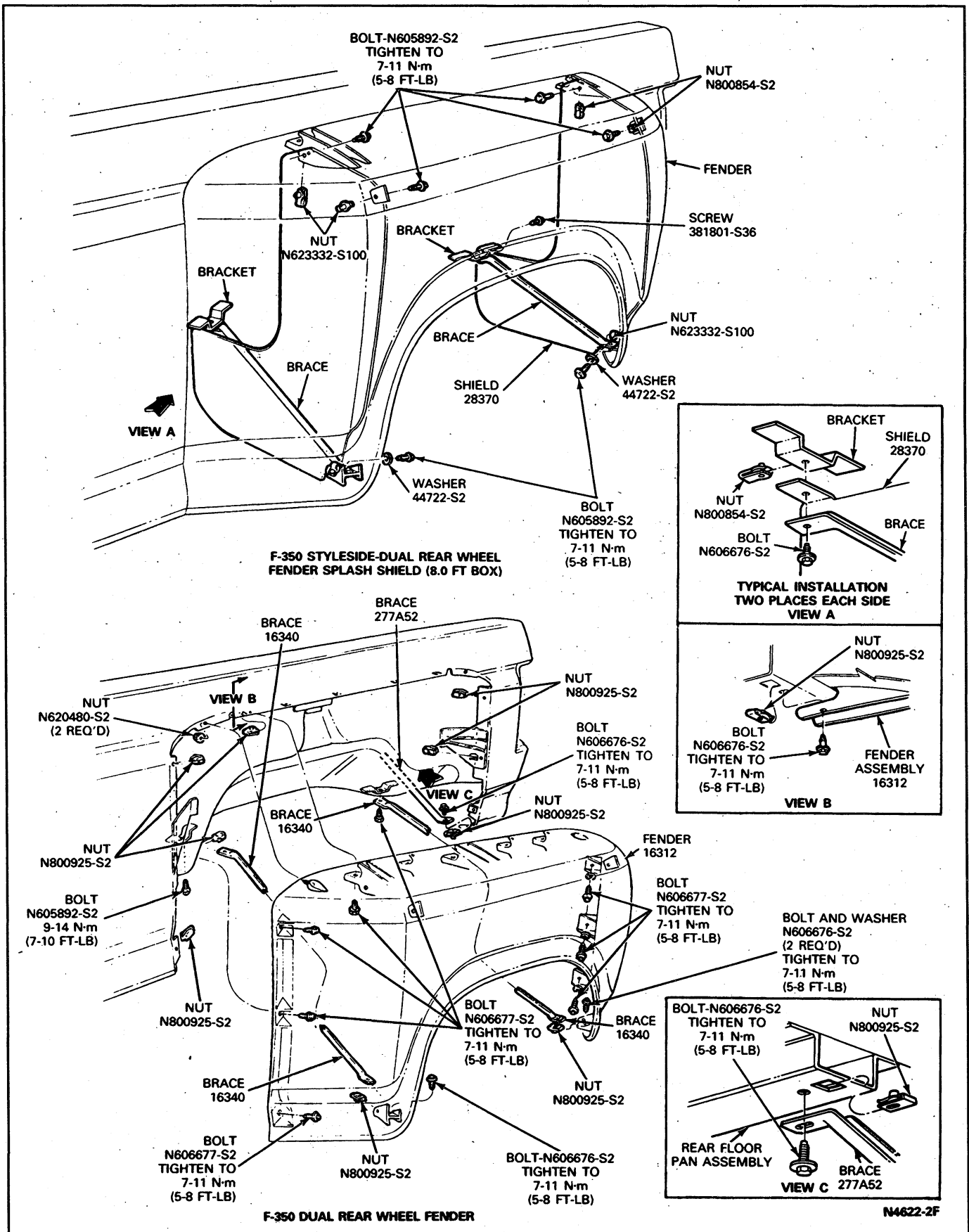


FIG. 4 Dual Wheel Rear Fender—F-350

2. Install bracket-to-frame retaining bolts and tighten nuts.

### Front Bumper—F-Super Duty Commercial Stripped Chassis

#### Removal

Refer to Fig. 6

1. Remove nuts and bolts retaining the front bumper to the reinforcement brackets.
2. Remove bumper.
3. Remove nuts and bolts retaining the bumper reinforcement brackets to the frame rails and number one crossmember.

#### Installation

1. Install the bumper reinforcement brackets if removed, tighten the retaining bolts to 80-120 N·m (59-88 ft-lb).
2. Position the bumper, install the nuts and bolts, and tighten to 80-120 N·m (59-88 ft-lb).

### Exterior Mouldings

#### Removal and Installation

Before removing the exterior mouldings, determine the type of retainer used if it is necessary to remove an interior trim panel (Figs. 7 through 10). Super Cab models use conventional exterior mouldings except in the area of the cab extension. If a weld stud is distorted

or broken off, it should be replaced with a drill point screw (379560-S101).

### Body Mounts

#### F-150—F-350—Regular, Super Cab and Super Duty Chassis Cab

The body mounts for F-150—F-350—regular and super cab are shown in Fig. 11.

#### Bronco

The body mounts for Bronco are shown in Fig. 12.

### Frame and Crossmembers

#### F-Super Duty Commercial Stripped Chassis and Motor Home Chassis

The frame and crossmembers for F-Super Duty Stripped Chassis Vehicles are shown in Figs. 13 and 14.

### Spare Tire Carrier

#### Under Frame—F-150—F-350, F-350 Chassis Cab and F-Super Duty Chassis Cab

The spare tire is stowed at the rear of the truck under the frame (standard location).

**CAUTION:** Due to possible air seepage at the tire rim or valve, the spare tire may lose air and become loose in the carrier. Therefore, check the spare tire at least twice a month for proper inflation. Any evidence of tire movement under hand pressure or foot kicking indicates that the spare tire requires

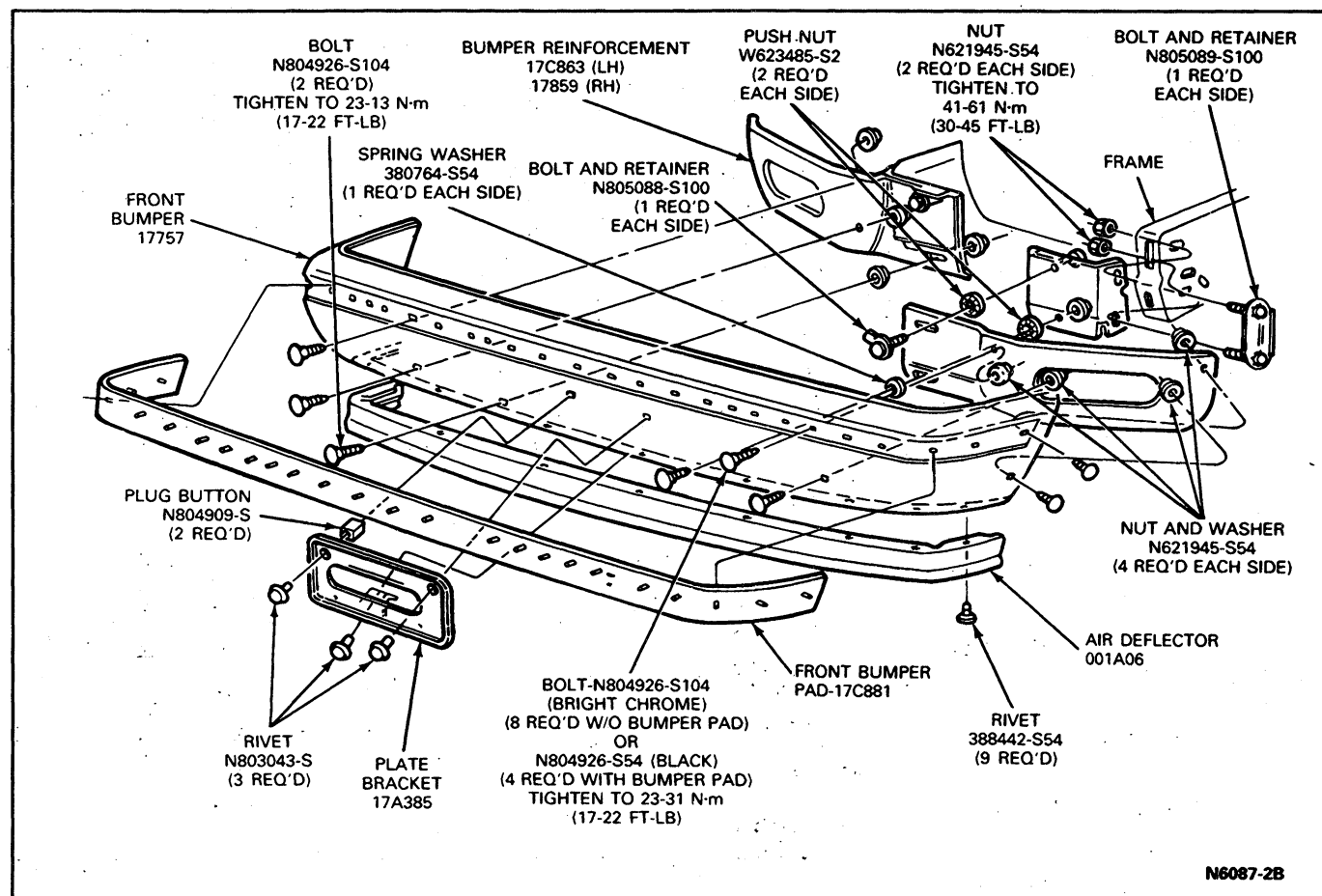


FIG. 5 Bumper Installation—F-150—F-350—F-Super Duty Chassis Cab and Bronco

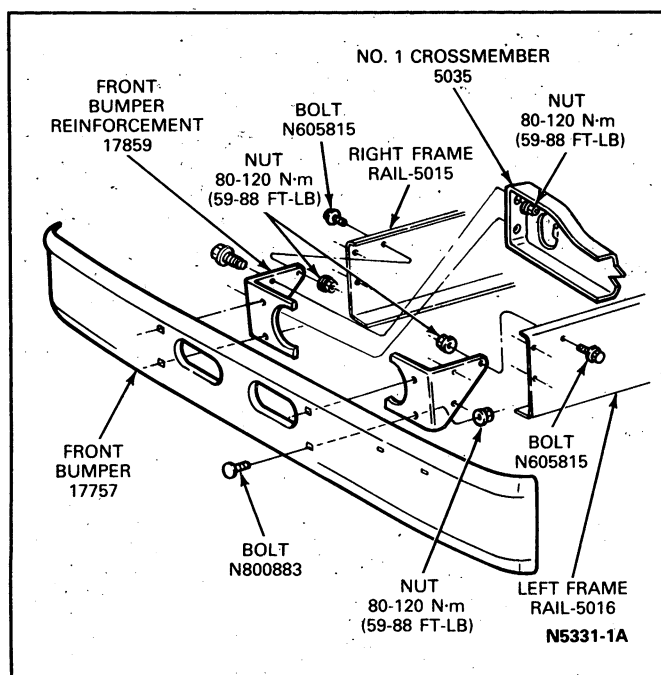
air. Correct the cause for leakage and then inflate the tire to the pressure recommended on the Safety Compliance Certification Label for original equipment tires located on door pillar—LH side.

NOTE: The tire valve stem is on the top side of the tire to reduce the possibility of accidental valve stem air leakage through contact with mud, brush, snow, ice, or some other obstruction.

**WARNING: TO AVOID POSSIBLE INJURY DO NOT PLACE ANY PART OF THE BODY UNDER THE CHANNEL WITH MOUNTED SPARE TIRE DURING ITS REMOVAL OR INSTALLATION.**

### Removal

1. Insert the tang of the lug nut wrench through the spare tire retaining eyebolt eye and turn the bolt until the tire is sufficiently loose from the upper retaining support (Figs. 15, 16 and 17). To avoid a sudden drop off of the tire do not turn the end of the eyebolt out of the retaining nut.
2. Align the eye of the eyebolt with the channel slot.
3. While holding the nut end of the wrench parallel to the ground, insert the tang of the wrench into the channel assembly tube. Lift up on the wrench and at the same time pull the eyebolt toward the tube and push on the wrench to pass the eyebolt shoulder through the channel keyhole.
4. Lower the spare tire assembly. Swing the channel to the rear of the vehicle and remove the wrench from the tube.
5. With the channel assembly end on the ground, remove the wheel retainer from the center bolt. If necessary insert the tang of the wrench through the retainer handle to provide additional leverage to loosen the retainer from the center bolt.
6. Remove the spare tire from the channel assembly.



**FIG. 6 Bumper Installation—F-Super Duty Commercial Stripped Chassis**

### Installation

1. To replace the spare tire under the frame, center the tire on the channel assembly (Figs. 15, 16 and 17). Shift the tire as necessary until it is balanced on the channel. Install and always tighten the retainer on the center bolt until the wheel is tight to the channel.
2. Install the tang of the lug nut wrench into the channel assembly tube and swing the channel under the eyebolt.
3. Lift the channel and insert the shoulder of the eyebolt through the keyhole. Shift the channel and eyebolt until the shoulder of the eyebolt is pushed all the way into the slot.
4. Insert the tang of the wrench into the eyebolt and always tighten the eyebolt until the tire cannot be moved by hand pressure. Adjustment of the driver side channel ball end bolt is not required when installing original equipment size wheel and tire.
5. Refer to the View Y in Figs. 15, 16 and 17 for proper position of the eyebolt after it has been tightened to secure the spare tire in stowage position.

**CAUTION: This eyebolt position is SPECIFIED to prevent possible channel separation and/or possible tire loss when the spare tire is loose in the channel. Tire looseness is caused by air leakage or by insufficient tightening of the eyebolt when installing the spare tire (flat or inflated).**

### Spare Wheel Only—F-250—F-350

When the wheel only (without tire) is ordered, it is located at the rear of the truck under the frame. A wood spacer is installed for shipment of the wheel only and must be removed when installing the tire (Figs. 15, 16 and 17).

After installing the wheel and tire in the carrying position, adjust the driver side channel ball and bolt and the eyebolt as necessary until the tire cannot be moved by hand pressure. Then tighten both bolts an additional 2 to 5 turns.

### GT Bar—Pickup Box Mounted

The roll bar is painted gloss black and normal painting procedure can be used when a repair is required.

### Removal

1. Remove nuts and bolts that secure GT bar to the front panel of the pickup box (Fig. 18).
2. From the underside of the vehicle, remove nuts that secure GT bar and braces to the floor of the pickup box.
3. Lift and remove complete GT bar and brace assembly from vehicle.

NOTE: When replacing any one section of the GT bar, it is only necessary to remove the attaching nuts and bolts that secure that particular section to the vehicle

### Installation

1. Position the GT bar and brace assembly to the vehicle and secure with nuts and bolts shown in Fig. 19.
2. Tighten all attaching nuts to 17-27 N·m (12-20 ft-lb).

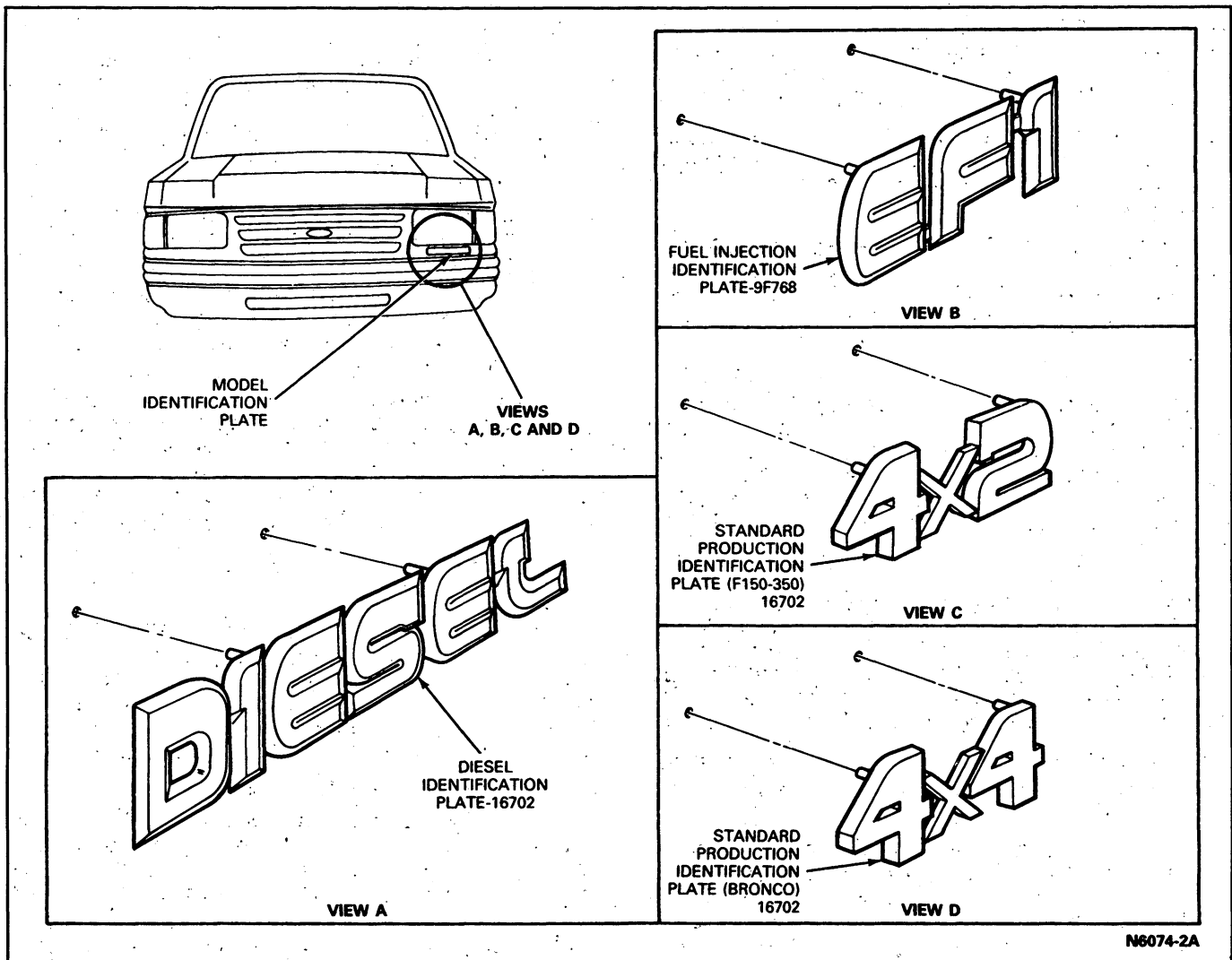


FIG. 7 Exterior Ornamentation, Front Identification Plates—F-150—F-350, F-Super Duty and Bronco

### Swing-Away (Bronco)

#### Removal and Installation

For swing-away spare wheel carrier removal and installation refer to Fig. 19.

### Inside Spare Wheel Carrier (Bronco)

#### Removal and Installation

For inside spare wheel carrier removal and installation refer to Fig. 20.

### Rear Bumper

#### Removal and Installation

The rear bumper installation for all models is shown in Fig. 21. To remove the bumper, remove the bumper bracket-to-frame attaching bolts and remove the bumper and brackets. Then, remove the brackets from the bumper. To install the bumper, install the brackets on the bumper. Position bumper to the frame and install bumper bracket-to-frame bolts.

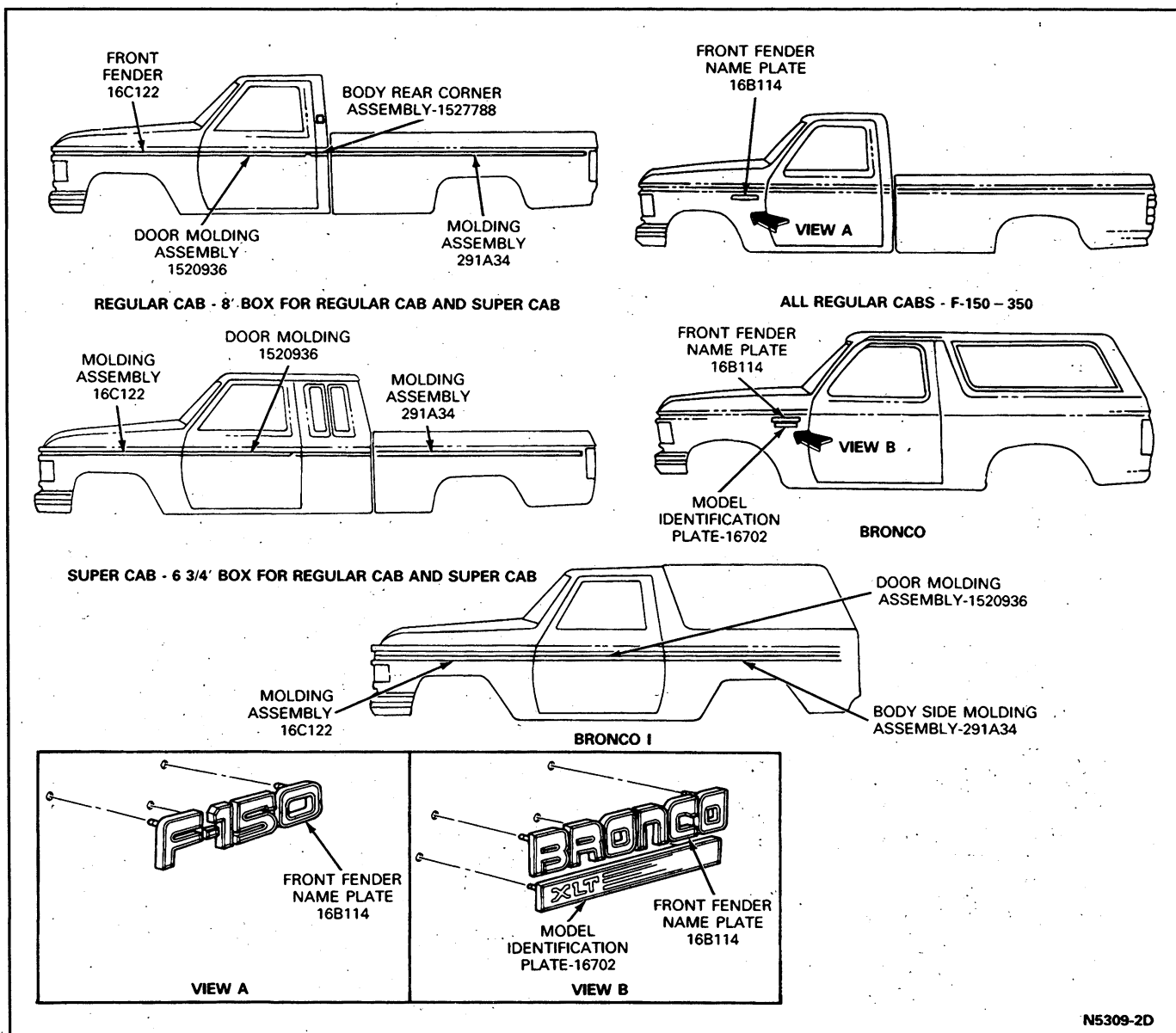


FIG. 8 Exterior Ornamentation, Body Side Mouldings with Tu-Tone Paint Only—F-150—F-350, Bronco

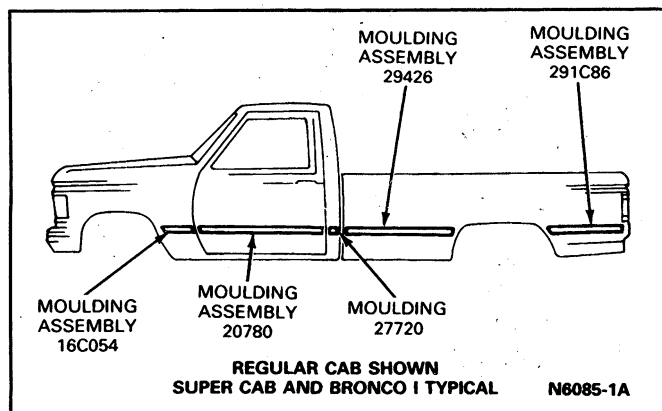


FIG. 9 Exterior Ornamentation, Wheel Lip and Body Side Moulding—F-150—F-350 Shown, Bronco Similar

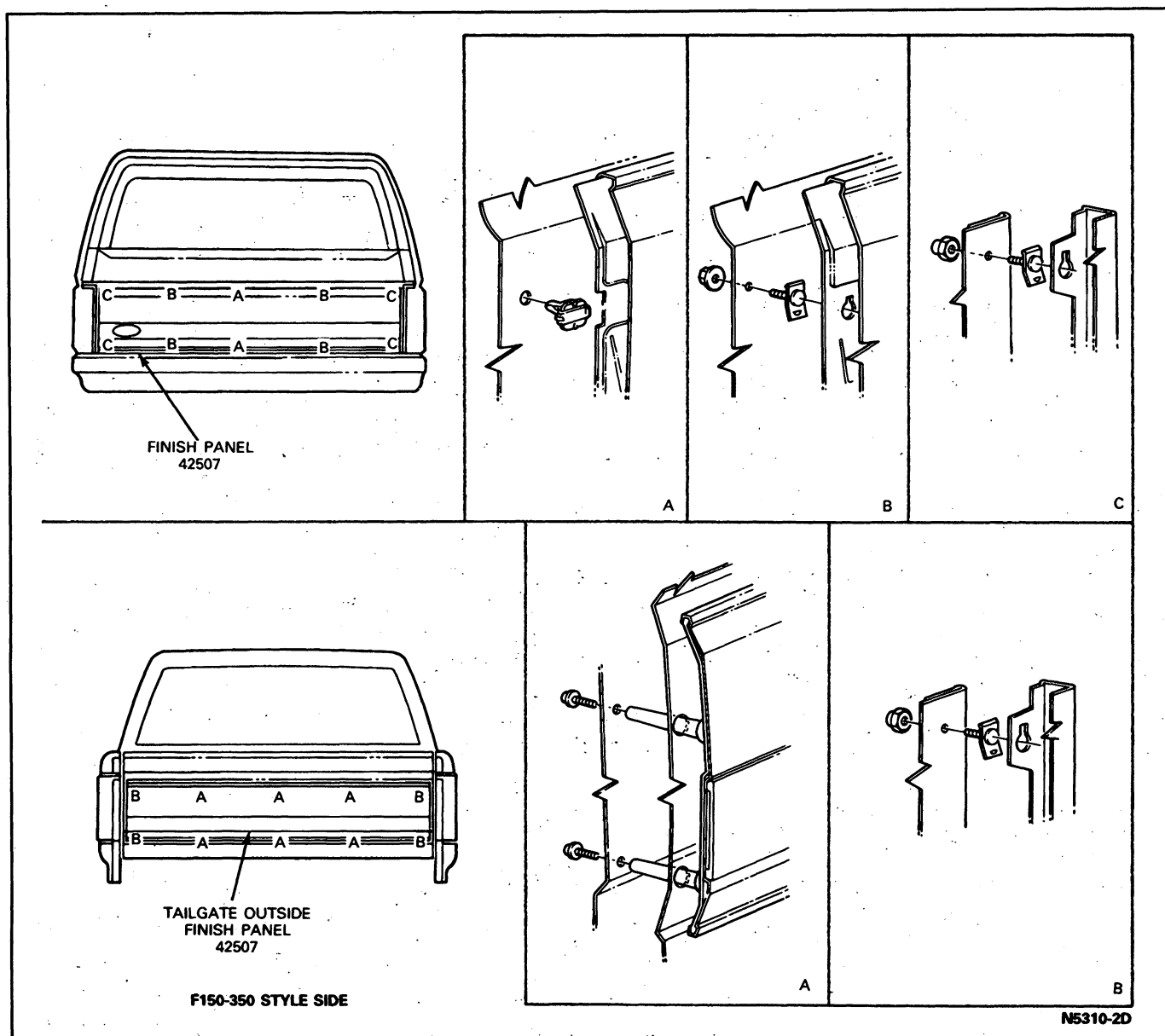
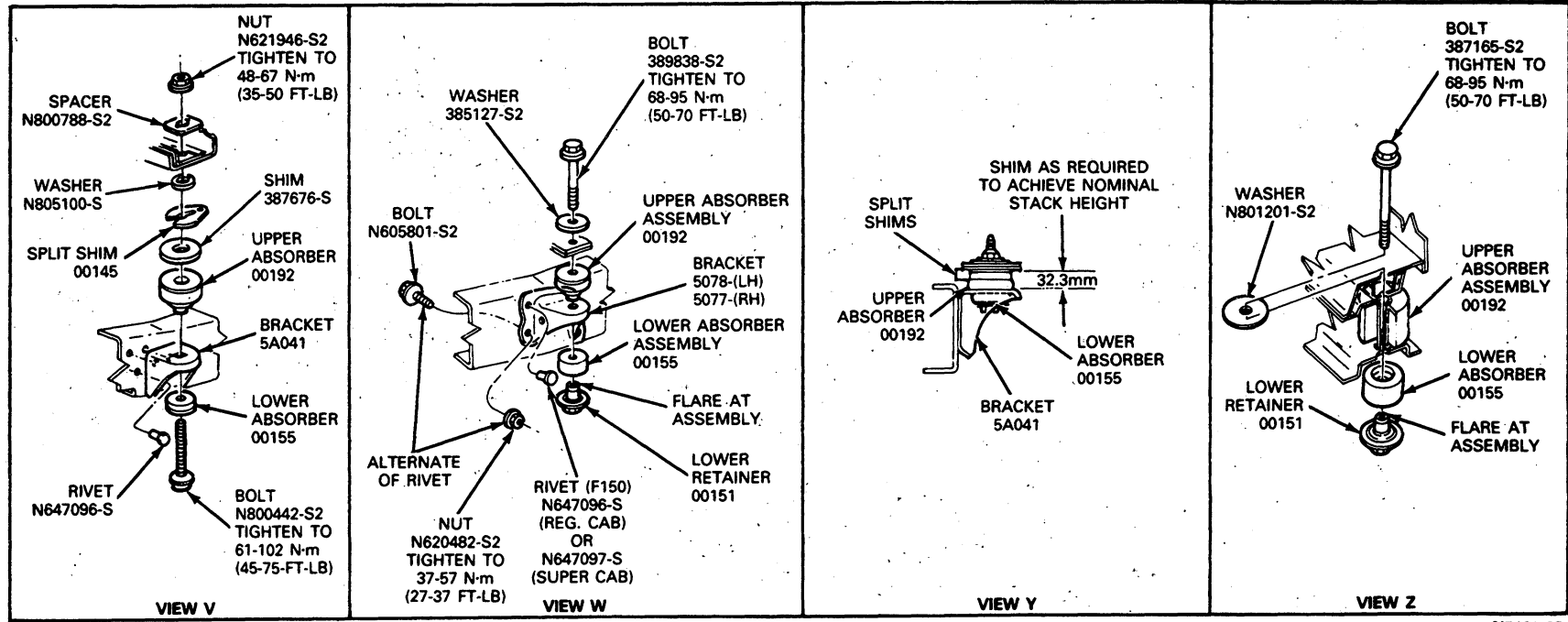
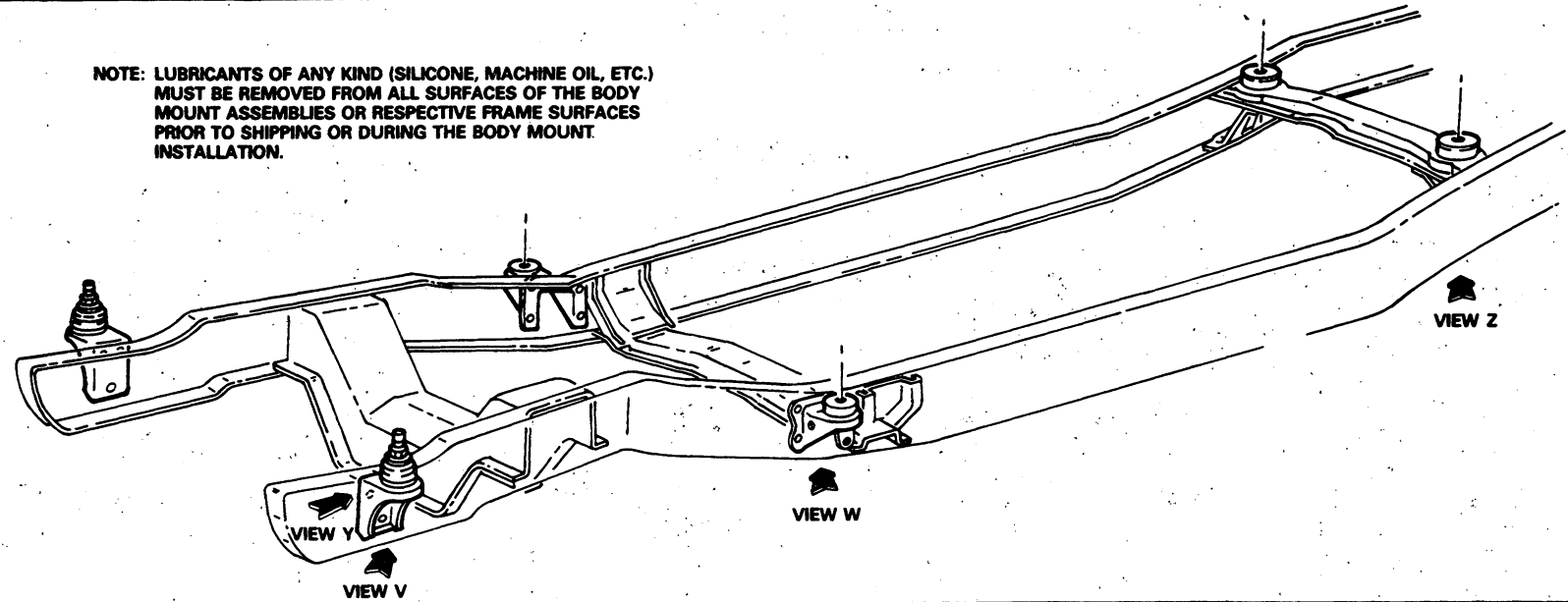


FIG. 10 Exterior Ornamentation and Tailgate Mouldings—Bronco, F-150—F-350



**NOTE: LUBRICANTS OF ANY KIND (SILICONE, MACHINE OIL, ETC.) MUST BE REMOVED FROM ALL SURFACES OF THE BODY MOUNT ASSEMBLIES OR RESPECTIVE FRAME SURFACES PRIOR TO SHIPPING OR DURING THE BODY MOUNT INSTALLATION.**



N5120-2D

FIG. 11 Body Mounts—F-150—F-350, F-Super Duty Chassis Cab

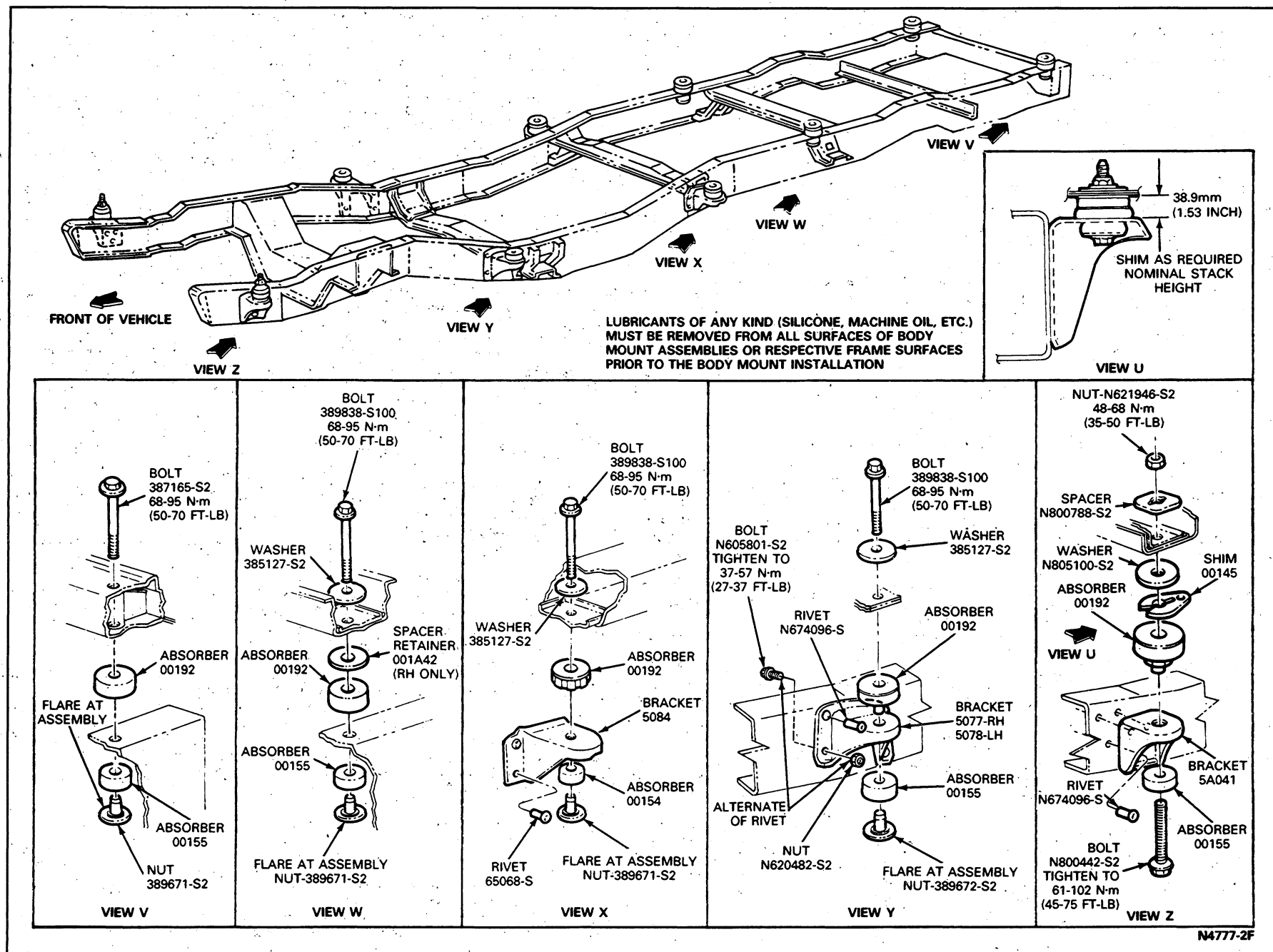


FIG. 12 Body Mounts—Bronco

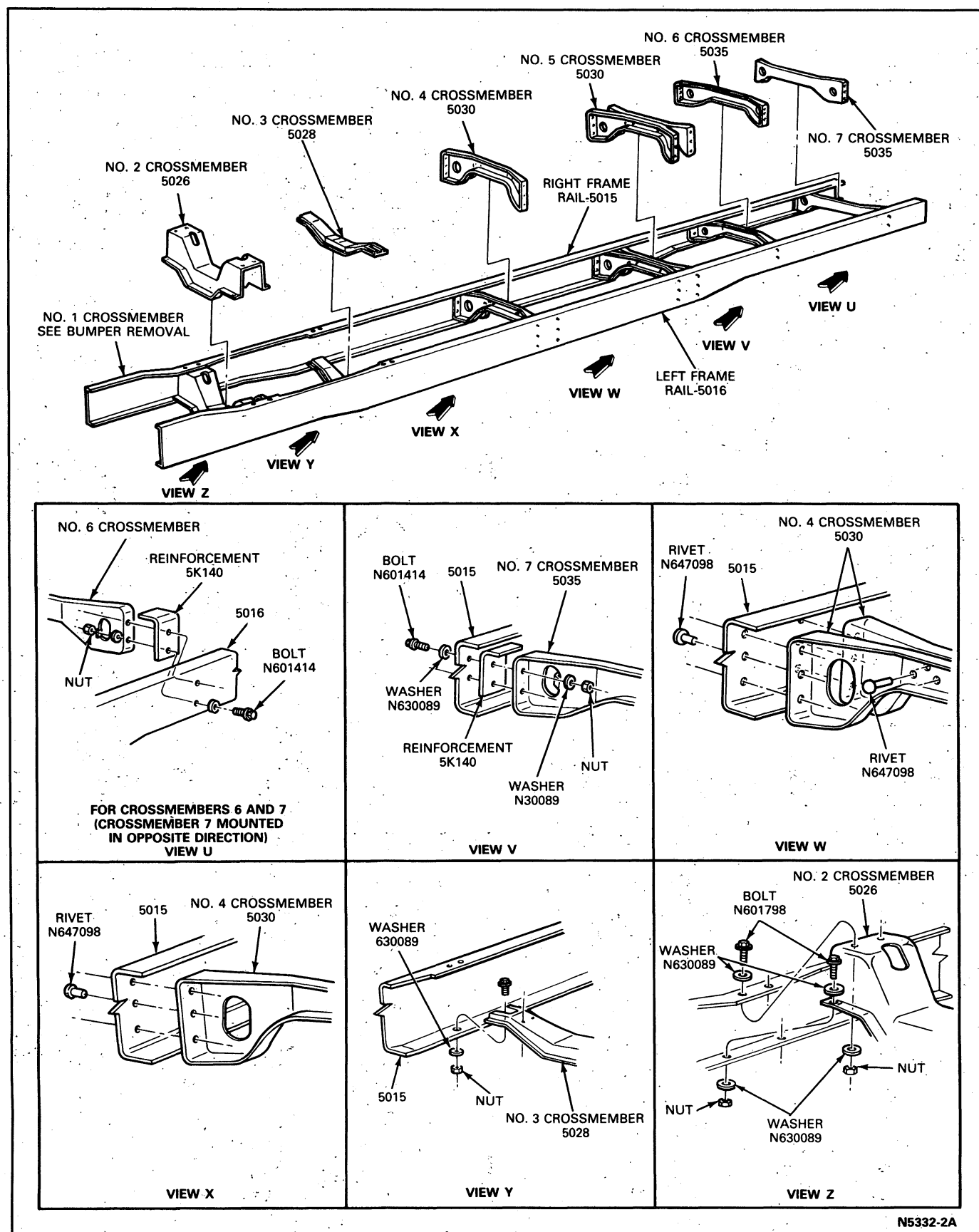


FIG. 13 Frame and Crossmember Installation—F-Super Duty Commercial Stripped Chassis (158 inch)

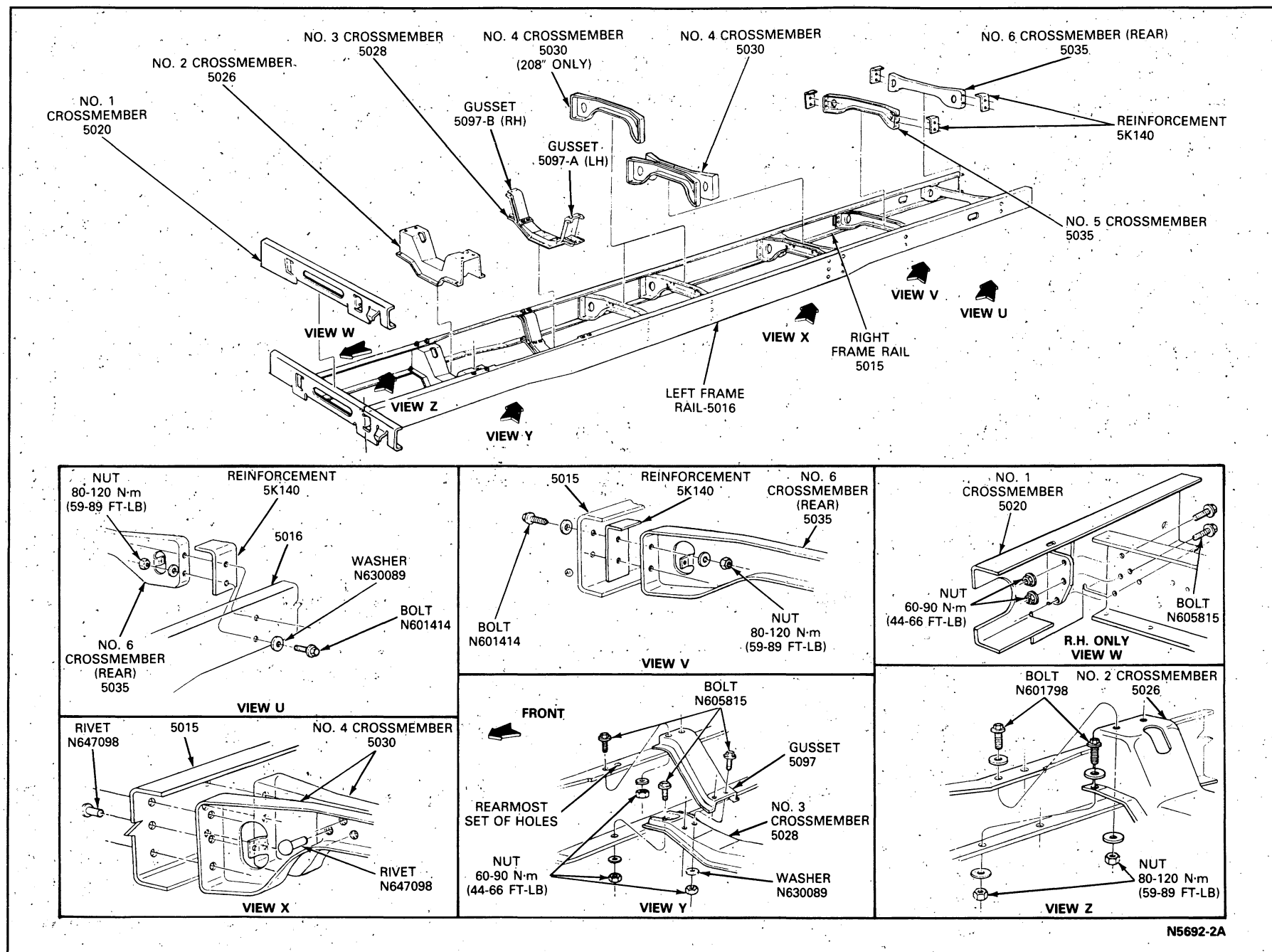


FIG. 14 Frame and Crossmember Installation—F-Super Duty Motor Home Chassis (178 and 208 inch)

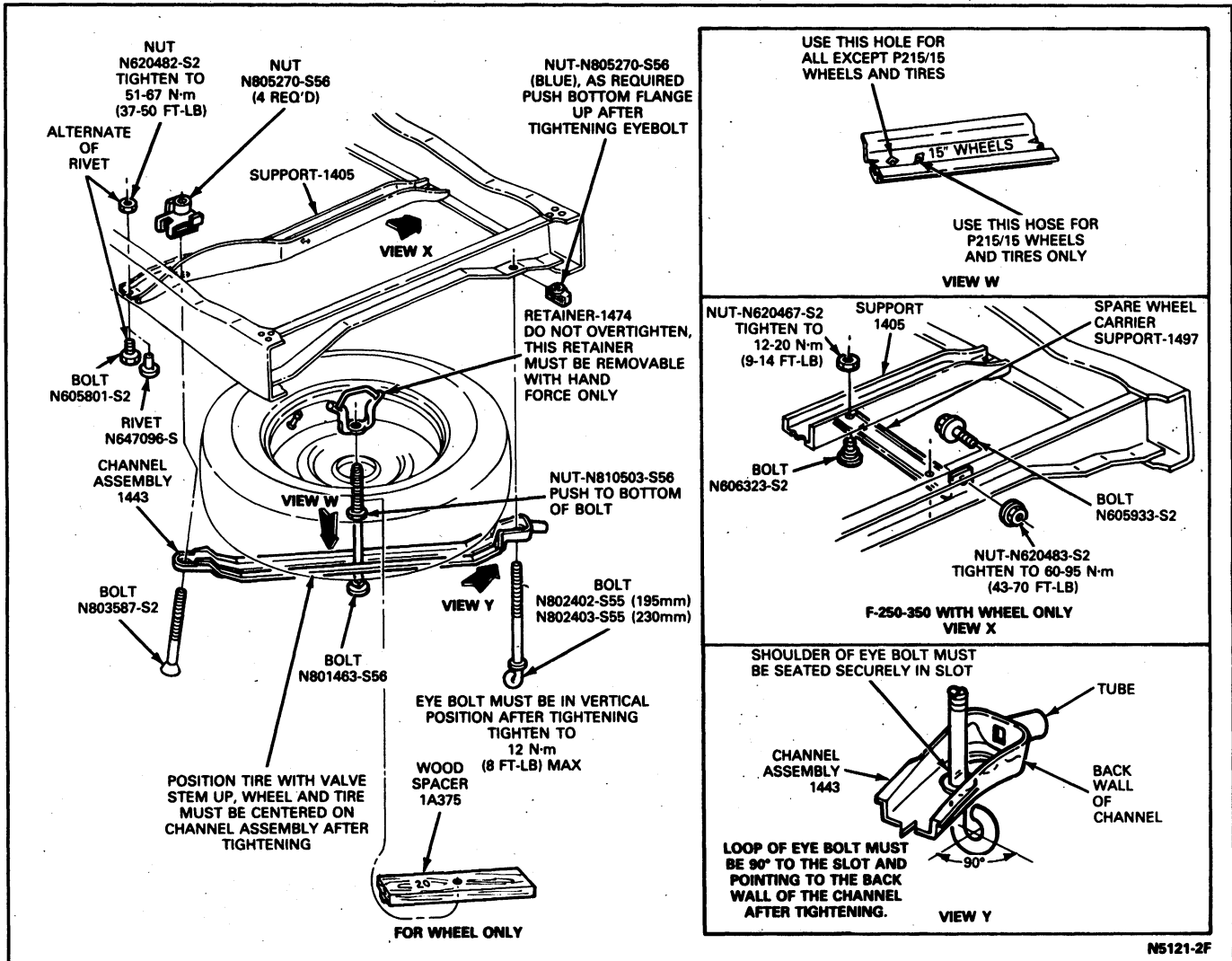


FIG. 15 Spare Tire Carrier—F-150—F-350 Without Aft Axle Tank

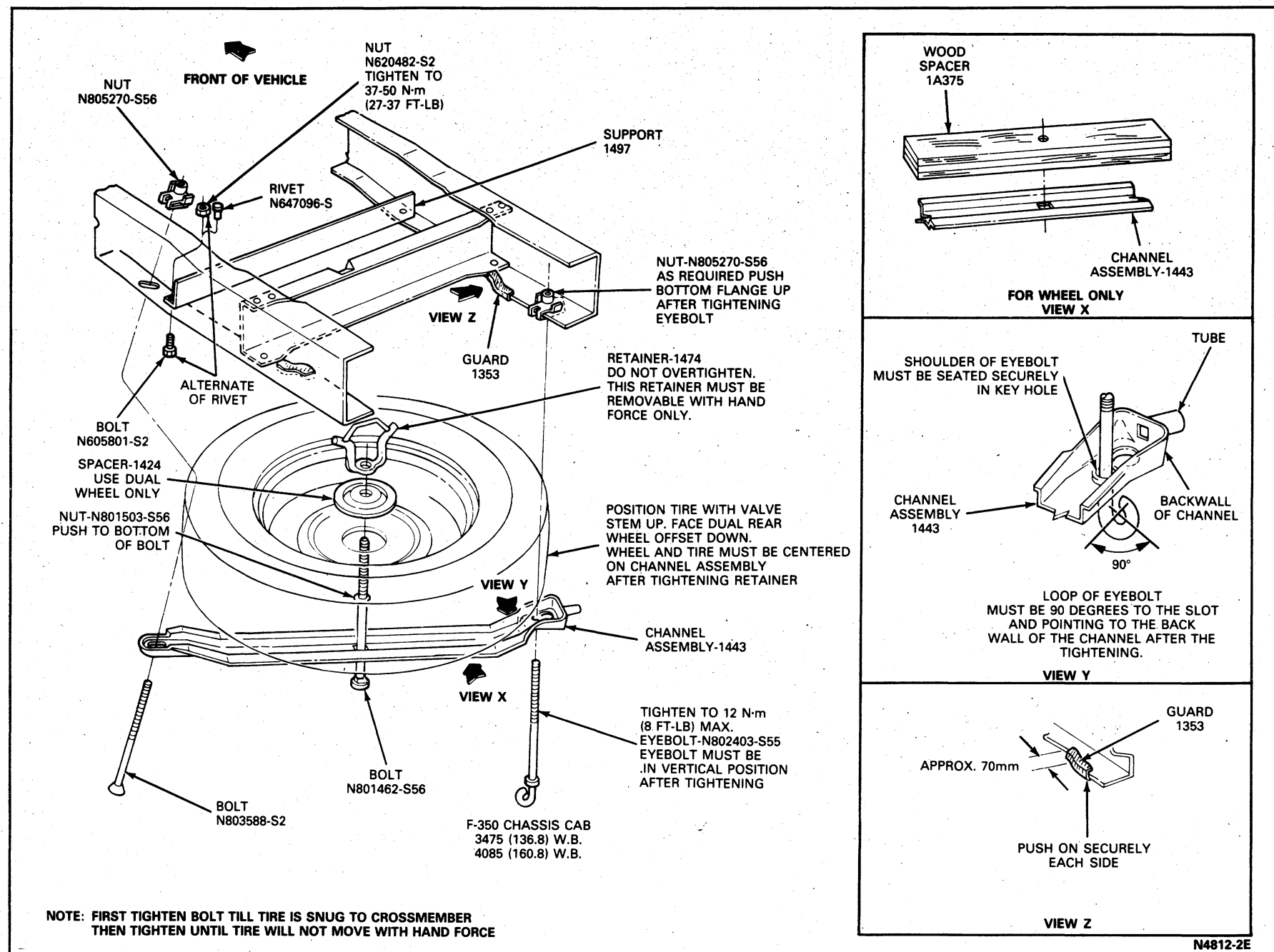


FIG. 16 Spare Tire Carrier—F-150, F-250—F-350 With Aft Axle Tank

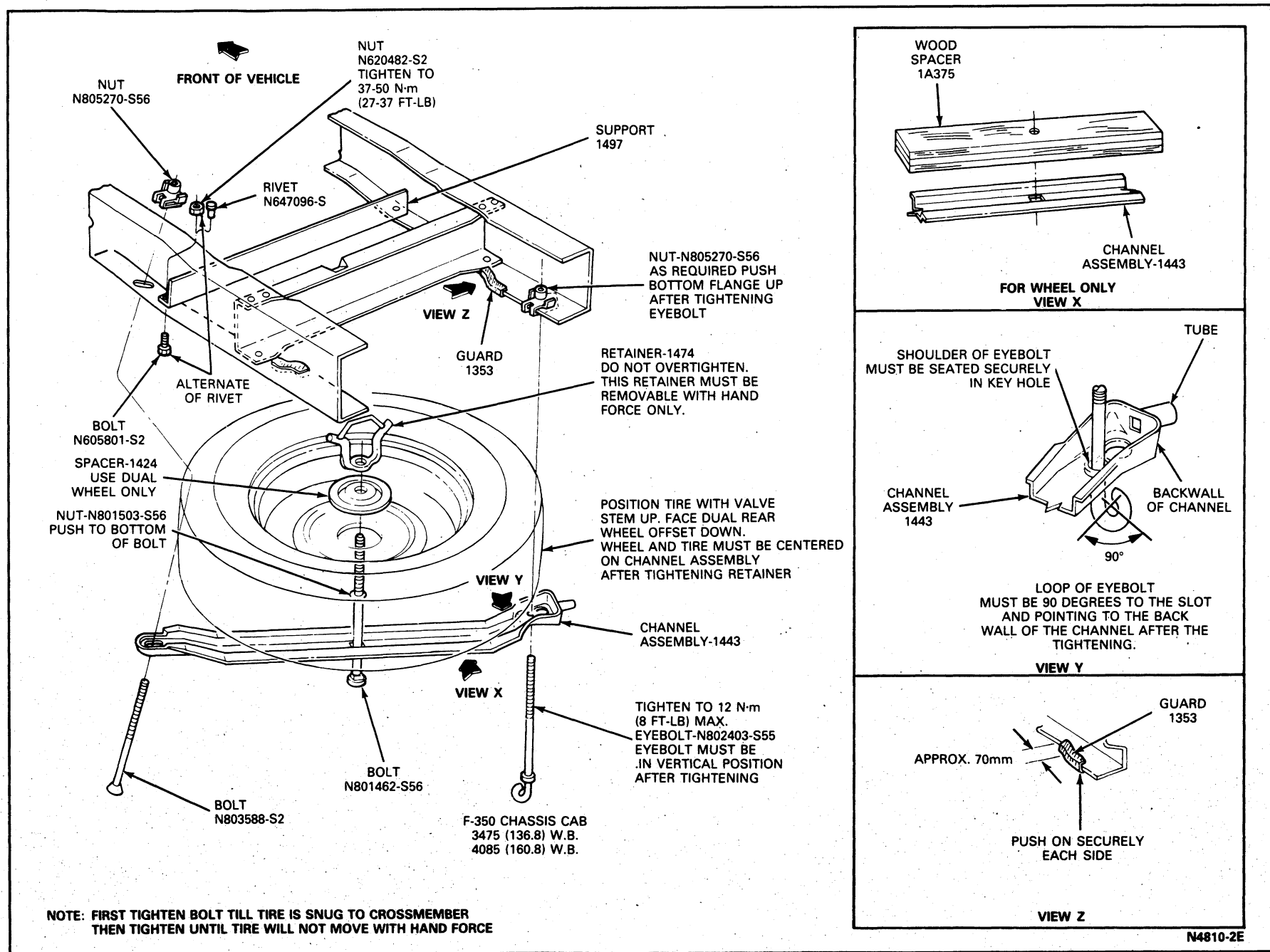
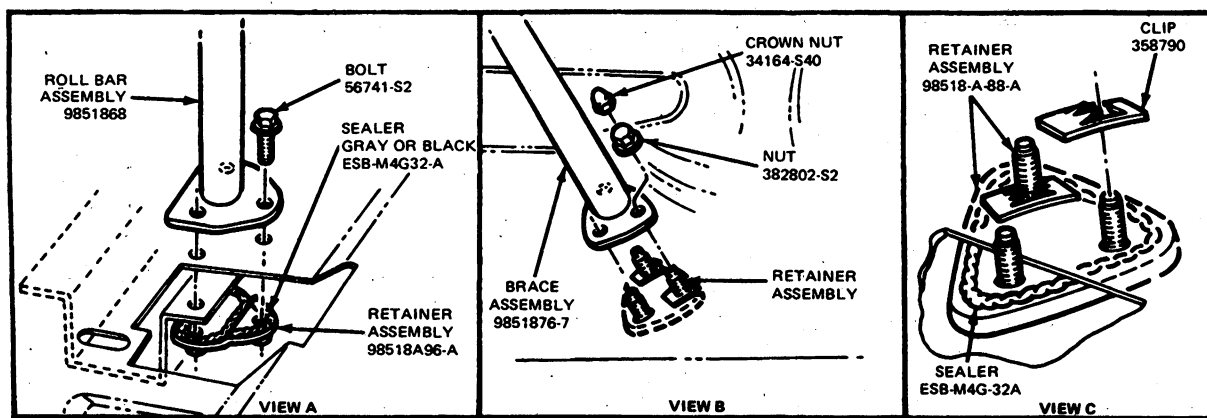
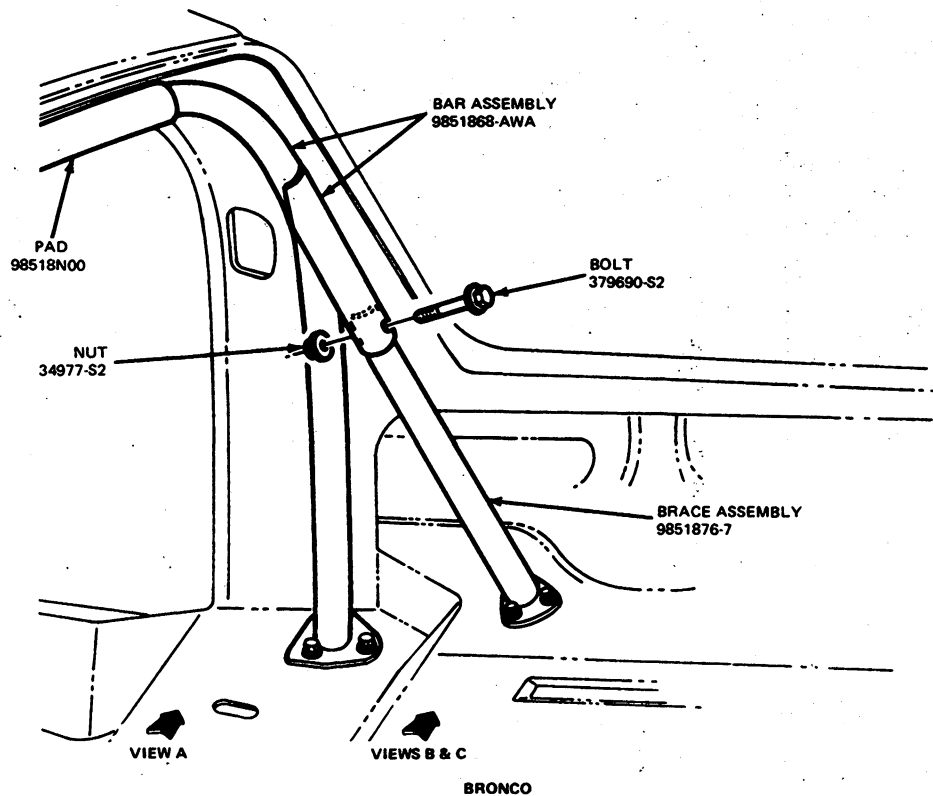


FIG. 17 Under Frame Spare Tire Carrier—F-350 Chassis Cab, F-Super Duty



N2428-20

FIG. 18 GT Bar-Pickup Box Mounted—Bronco and F-150—F-350



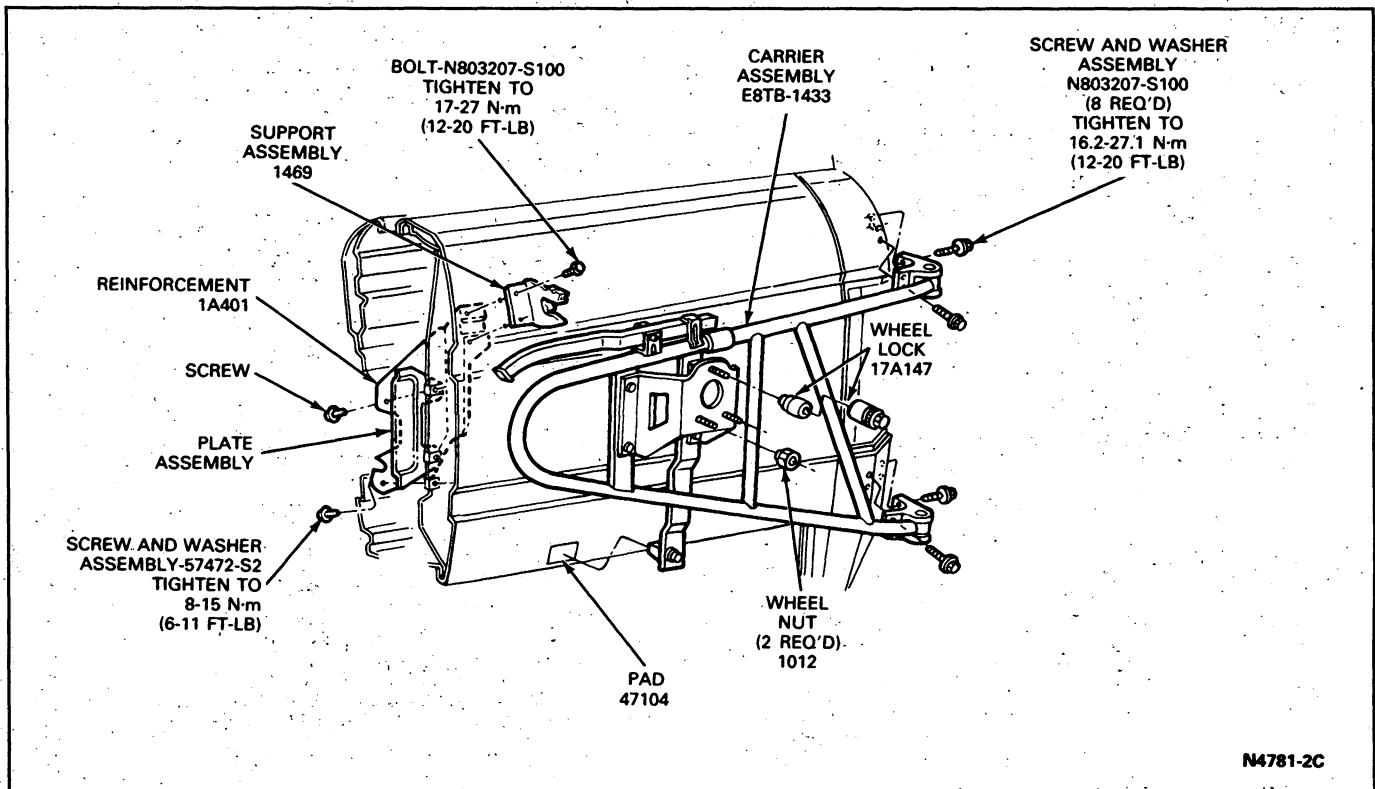


FIG. 19 Swing-Away Spare Wheel Carrier—Bronco

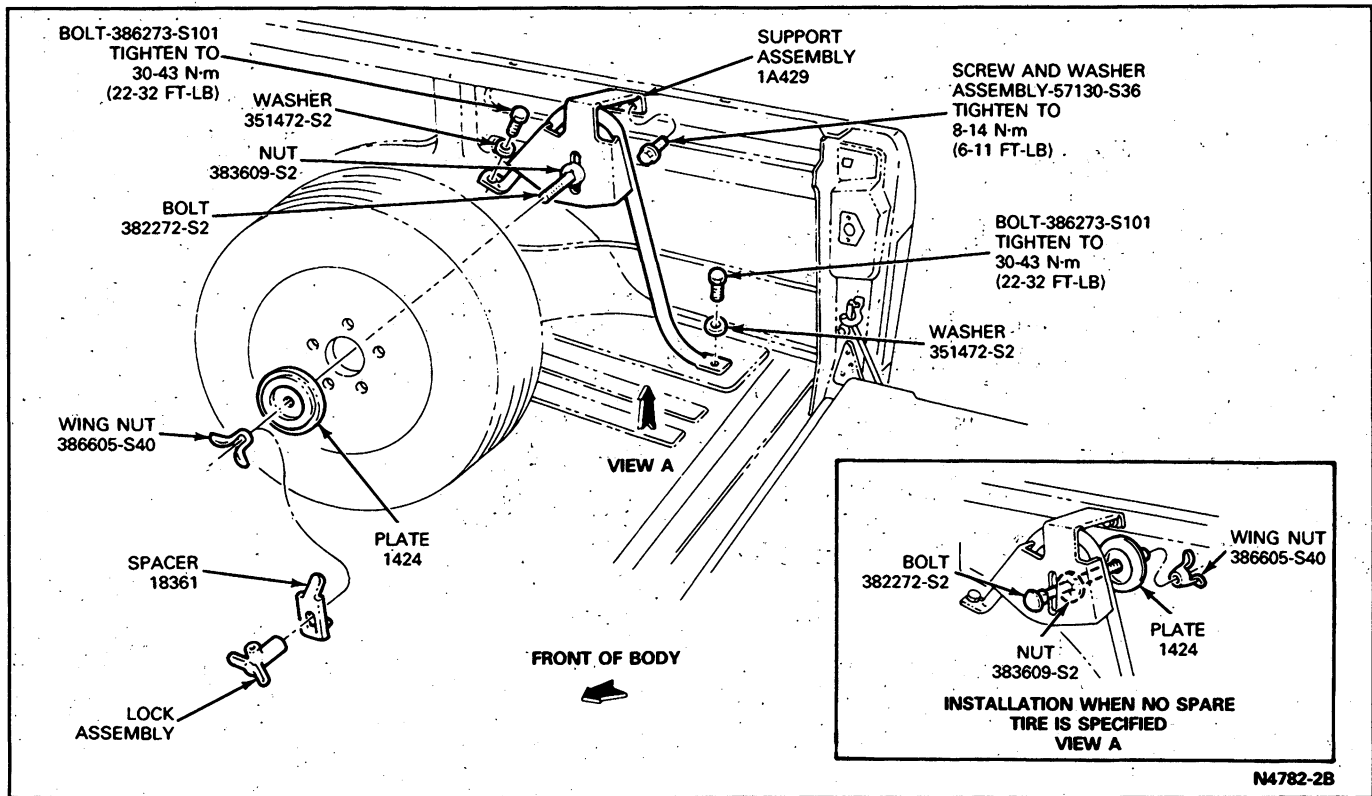


FIG. 20 Inside Spare Wheel Carrier—Bronco

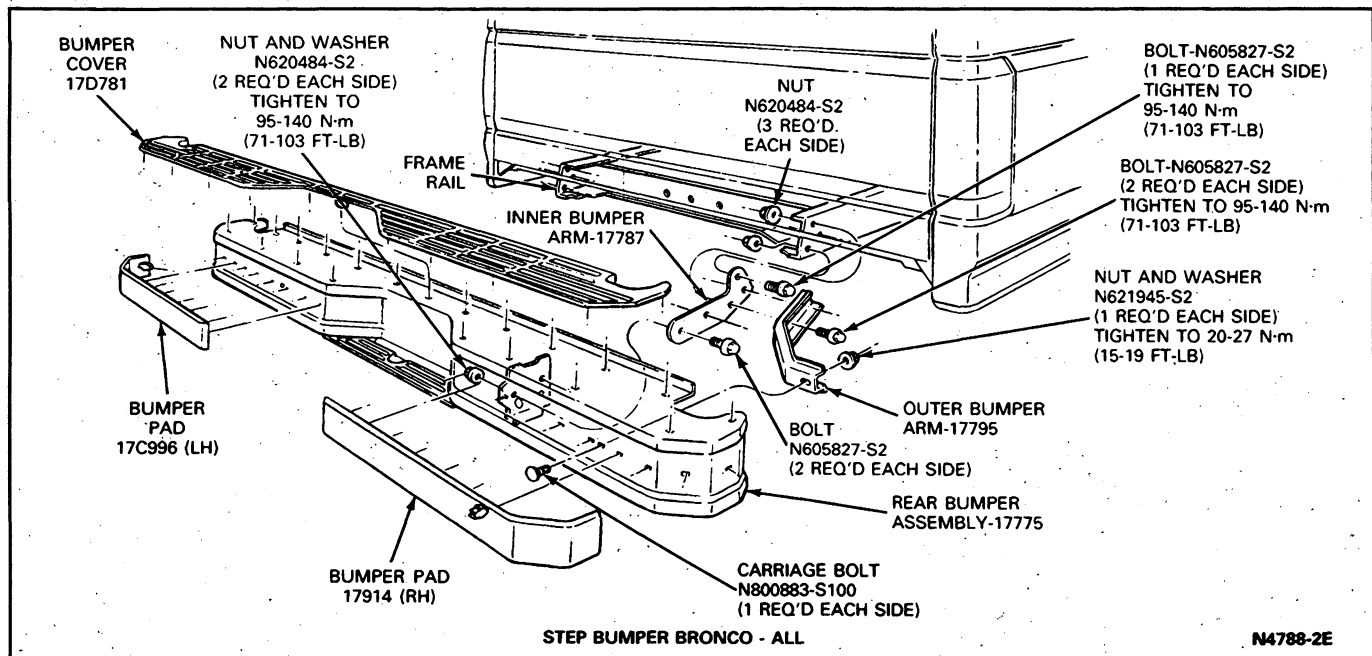


FIG. 21 Rear Bumper

# SECTION 47-52 Body, Trim and Mounting—Econoline

SUBJECT	PAGE	SUBJECT	PAGE
<b>REMOVAL AND INSTALLATION</b>		<b>REMOVAL AND INSTALLATION (Cont'd)</b>	
Body Mounts .....	47-52-5	Radiator Grille Opening—Lower Panel .....	47-52-1
Body Sealer .....	47-52-5	Rear Bumper .....	47-52-3
Exterior Mouldings .....	47-52-5	Rear Bumper Pad .....	47-52-4
Frame Dimensions .....	47-52-5	Rear Step Bumper .....	47-52-4
Front Bumper .....	47-52-1	Rear Step Bumper Pad .....	47-52-4
Front Bumper Pad .....	47-52-3	Spare Tire Carrier .....	47-52-5
Front Fender .....	47-52-1	Inside Mounting .....	47-52-5
License Plate Bracket (Front) .....	47-52-3	Outside Mounting .....	47-52-6
Radiator Grille .....	47-52-1	<b>VEHICLE APPLICATION</b> .....	47-52-1

## VEHICLE APPLICATION

E-150 Through E-350 and Club Wagon.

## REMOVAL AND INSTALLATION

### Radiator Grille

#### Removal

1. Unlatch and raise the hood. Secure the hood in position with the hood support rod.
2. Remove the four screws attaching the center of the grille to the radiator grille supports (Fig. 1).
3. Remove the four screws at the bottom of the grille.
4. Remove the nine plastic rivets located on the upper flange of the grille which attach to the radiator support and the gussets.
5. Separate the grille from the front of the vehicle.

#### Installation

1. Position the grille to the front of the vehicle.
2. Install the two center screws, but do not tighten fully. Check the alignment on grille for uniform spacing relative to the fender screws. Tighten the center screws to 0.90-2.25 N·m (8-20 in-lb) (Fig. 1).
3. Install the nine plastic rivets across the top of the grille attaching the top flange to the radiator support and the side gussets.
4. Install the four screws (at the bottom of the grille) attaching the grille to the radiator grille opening lower panel.

### Radiator Grille Opening—Lower Panel

#### Removal

1. Remove the front bumper as outlined (Fig. 3).
2. Remove the radiator grille as outlined (Fig. 1).
3. Remove the two lower center screws attached to the radiator grille support bracket.
4. Remove the two screws attaching the outer radiator support at the upper tabs.
5. Remove the two side bolts which attach to the front fenders, two bolts per side (Fig. 2).

## Installation

1. Install the two side bolts, two per side, retaining the ends of the radiator grille opening lower panel to the front fenders (Fig. 2).
2. Install the two lower center screws attached to the radiator grille support (Fig. 1).
3. Install two self-tapping screws through the upper tabs of the outer radiator support.
4. Install the bumper assembly as outlined (Fig. 3).
5. Install the radiator grille as outlined (Fig. 1).

### Front Fender

#### Removal

1. Remove the radiator grille as outlined.
2. Remove the two side bolts attaching the end of the radiator grille opening lower panel to the fender (Fig. 2).
3. Remove the three screws attaching the lower edge of the fender to the wheel housing.
4. Remove the lower fender rear attaching screw (Fig. 2) and shim(s).
5. Open the door and remove the upper fender rear attaching screw and shim(s).
6. Remove the two screws attaching the front edge of the fender to the radiator support.
7. Remove the three screws and shim(s) attaching the top edge of the fender, and remove fender.

#### Installation

To install the front fender, reverse Steps 1 through 7.

Loosely install all attaching screws until the fender is adjusted for proper fit and appearance. Do not exceed two shims at any location except at the lower fender rear attaching screw. When all shims are installed, tighten all attaching screws to specification, then install the radiator grille as outlined.

### Front Bumper

#### Removal

1. Remove license plate bracket and bumper pad as outlined (Fig. 3).

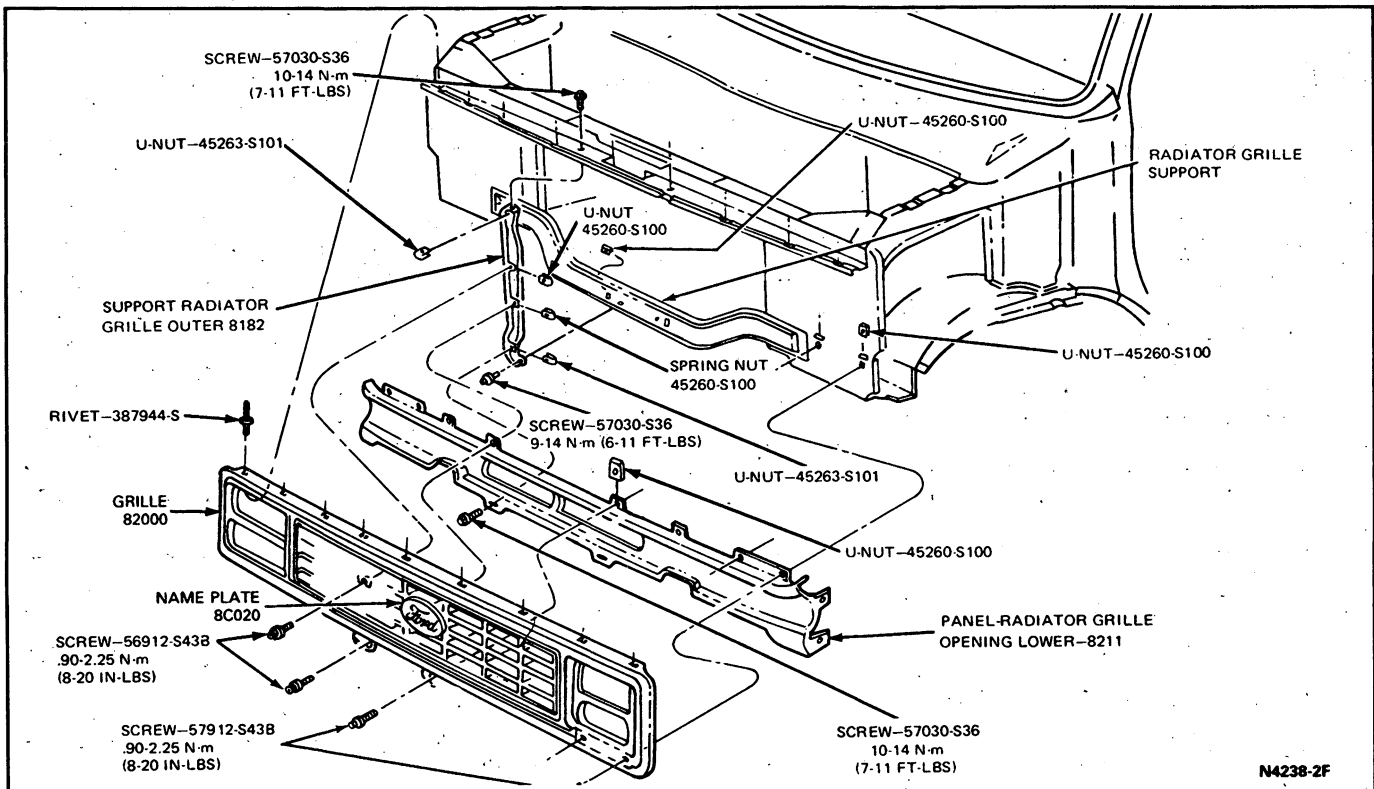


FIG. 1 Grille Installation

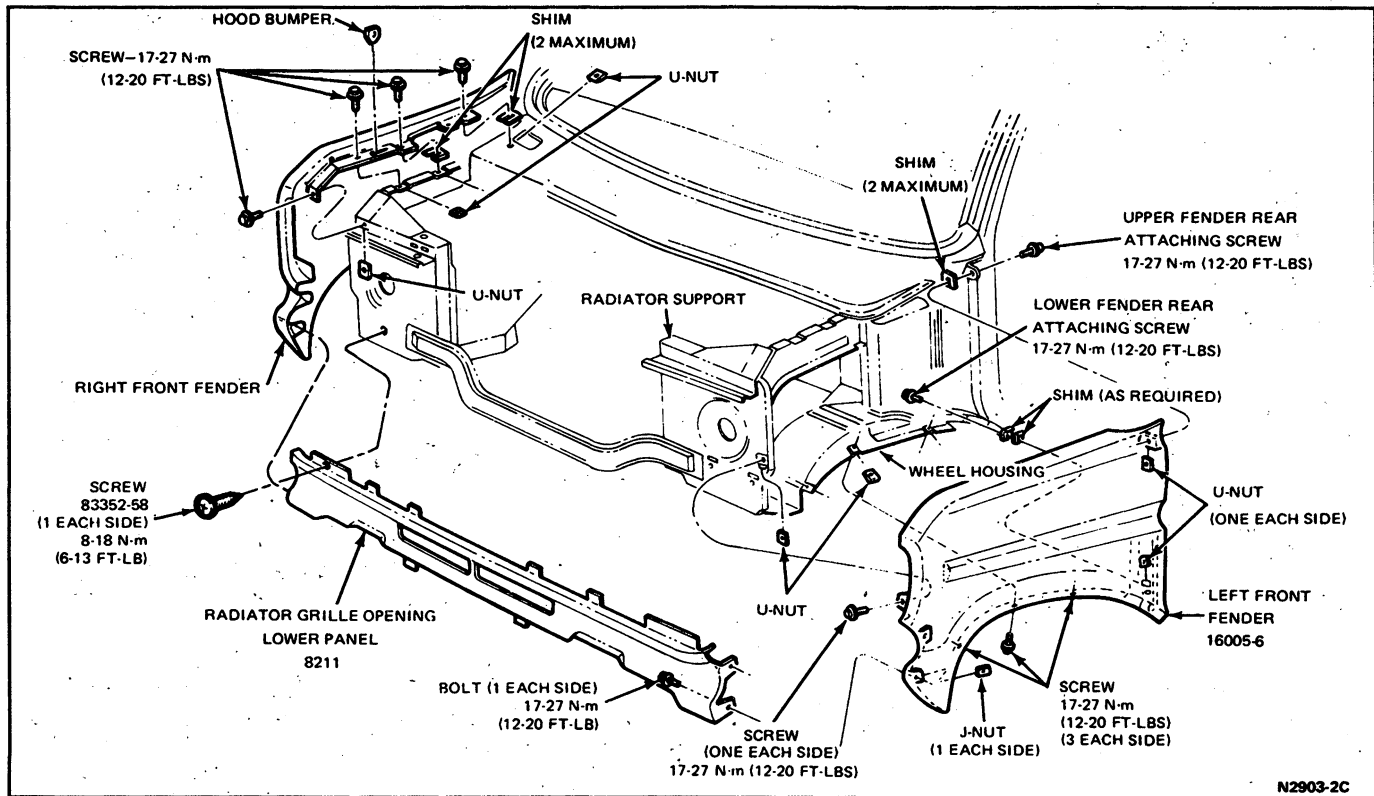


FIG. 2 Front Fender Installation

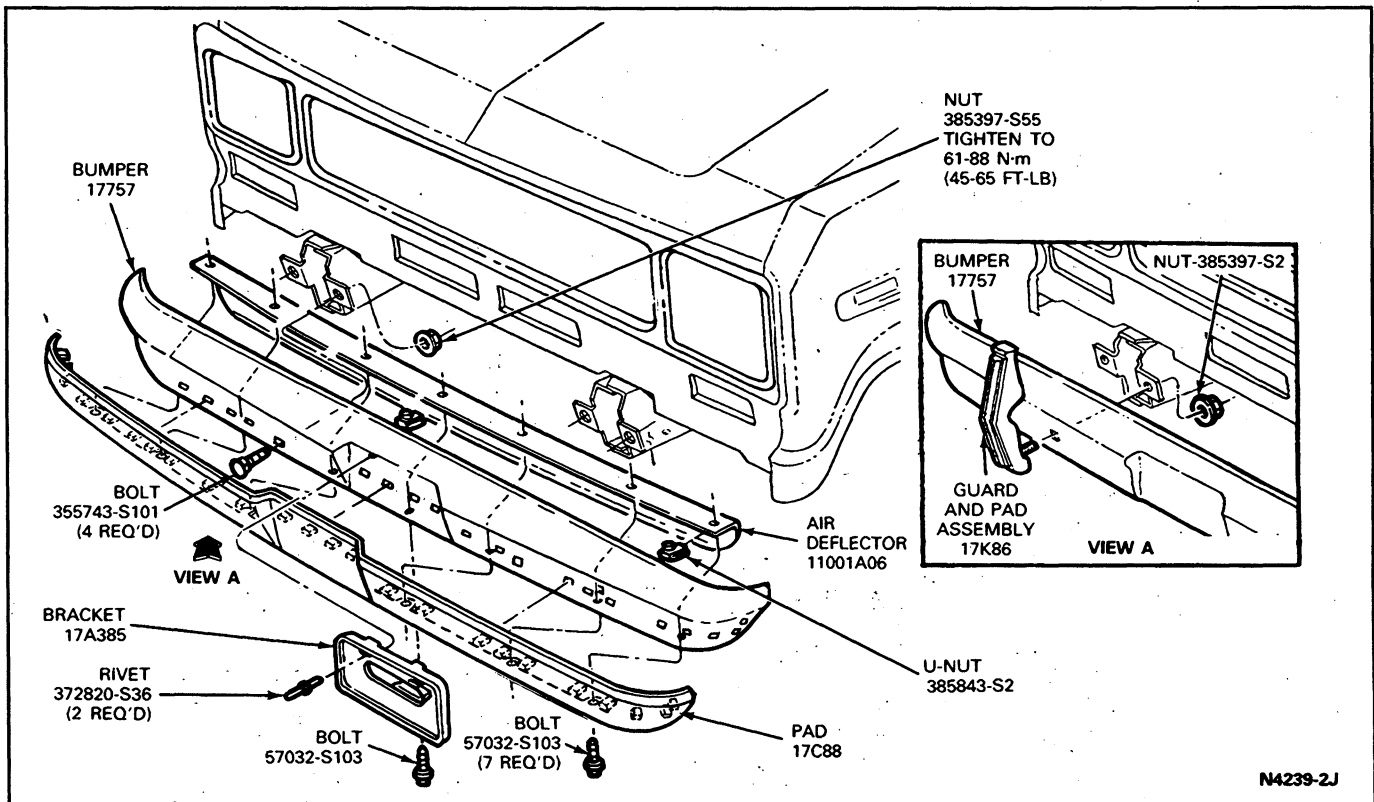


FIG. 3 Front Bumper and Bumper Guards

- Remove four bolts and nuts retaining the bumper. Carefully remove bumper.

#### Installation

- Loosely fit the four bolts and nuts retaining the bumper. Ensure proper bumper position and body-to-bumper clearance.
- Tighten attaching nuts to 61-88 N·m (45-65 ft-lb).
- Install bumper pad and license plate bracket as outlined.

#### Front Bumper Pad

##### Removal

- Remove license plate bracket as outlined.
- Using a pair of pliers, carefully compress the plastic bumper pad retaining barbs. Access the bumper pad retaining barbs from the inner surface of the bumper.
- Pull each portion of the pad free of the bumper as it is released. Remove pad.

##### Installation

- Align the center of the bumper pad with the center of the bumper and press this small area into place.
- Stretch the pad and work the pad barbs into place. Work from the center out, switching from left of center to right of center, as the pad is gradually stretched from the center to the outer edges of the bumper. If necessary, use a small rubber hammer to tap each barb into place in its rectangular slot in the bumper.
- If the barbs are damaged and can not be securely fastened to bumper, replace pad.

- Install license plate bracket as outlined.

#### License Plate Bracket (Front)

##### Removal

- To remove bracket, drill out the two rivets retaining the top of the bracket to the bumper.
- Remove the lower center bolt at the base of the bracket. Remove bracket.

##### Installation

- Install two new rivets through the top edge of the bracket.
- Install the lower center bolt at the base of the bracket.

#### Rear Bumper

##### Removal

- Remove bumper pad as outlined.
- Remove four nuts and bolts attaching the bumper to the support brackets (Fig. 4).
- Remove bumper.

##### Installation

- Position bumper on support brackets and loosely install the four nuts and bolts. Ensure proper bumper position and body-to-bumper clearance.
- Tighten attaching nuts to 27-41 N·m (20-30 ft-lb).
- Install bumper pad as outlined in this Section.

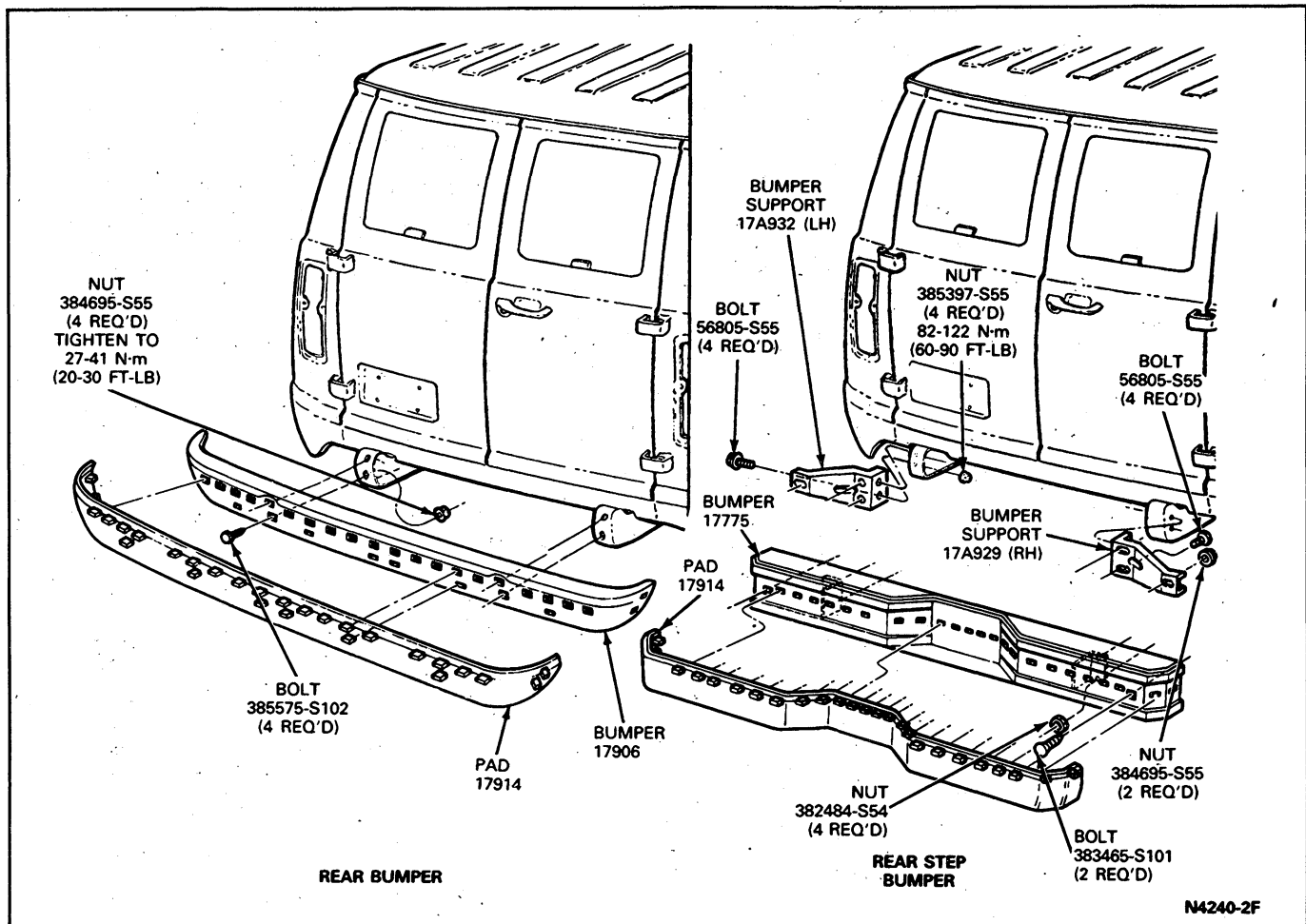


FIG. 4 Rear Bumper

## Rear Bumper Pad

### Removal

- Using a pair of pliers, carefully compress the plastic bumper pad retaining barbs. Access the bumper pad retaining barbs from the inner surface of the bumper.
- Pull each portion of the pad free of the bumper as it is released. Remove pad.

### Installation

- Find the center of the bumper pad and mark it with a piece of chalk.
- Find the center of the bumper and align it with the center of the pad.
- Press a small area at the center of the pad into place.
- Stretch the pad and work the pad barbs into place. Work from the center out, switching from left of center to right of center, as the pad is gradually stretched from the center of the outer edges of the bumper. If necessary, use a small rubber hammer to tap each pad barb into place in its rectangular slot in the bumper.

## Rear Step Bumper

### Removal

- Remove bumper pad from bumper as outlined.

- Remove six nuts and bolts securing the bumper to the bumper bracket.
- Remove bumper. If required, remove four bolts that secure brackets to frame. Remove brackets.

### Installation

- If necessary, install brackets and tighten four attaching nuts and bolts to 82-122 N·m (60-90 ft-lb).
- Position bumper on support brackets and loosely attach the six nuts and bolts. Ensure proper bumper position and body-to-bumper clearance.
- Tighten attaching nuts securely.
- Install bumper pad as outlined.

## Rear Step Bumper Pad

### Removal

- Using a pair of pliers, carefully compress the plastic bumper pad retaining barbs. Access the bumper pad retaining barbs from the inner surface of the bumper.
- Pull each portion of the pad free of the bumper as it is released. Remove pad.

### Installation

- Align the center of the bumper pad with the center of the bumper and press this small area into place.

2. Stretch the pad and work the pad barbs into place. Work from the center out, switching from left of center to right of center, as the pad is gradually stretched from the center to the outer edges of the bumper. If necessary, use a small rubber hammer to tap each barb into place in its rectangular slot in the bumper.
3. If the barbs are damaged and can not be securely fastened to bumper, replace pad.

## Exterior Mouldings

### Removal and Installation

Before removing the exterior mouldings, determine by the type of retainer used if it is necessary to remove an interior trim panel (Figs. 5 through 9). If a weld stud is distorted or broken off, it should be replaced with screw (379560-S101).

## Body Mounts

### Removal and Installation

The E-150—E-350 body mounts are shown in Figs. 10, 11 and 12.

## Body Sealer

For sealer types and application procedures refer to Section 47-01, Body Shell, Exterior Trim, Frame and

Underbody—General. For test procedure for locating dust and water leaks refer to Diagnosis and Testing in Section 47-01, Body Shell, Exterior Trim, Frame and Underbody—General.

## Frame Dimensions

For E-150—E-350 frame checking and repair procedures refer to Section 47-01, Body Shell, Exterior Trim, Frame and Underbody—General.

## Spare Tire Carrier

### Removal and Installation

The various spare tire carrier installations are shown in Figs. 13 through 15.

## Inside Mounting

On inside installations, remove the standard retaining nut or optional locknut to remove tire from mounting (Figs. 13 and 14).

**CAUTION:** When installing the spare tire under the rear seat on 12-passenger Club Wagons, Club Wagons with optional seat/bed, and 15-passenger Super Wagons, position the tire with the valve stem downward to prevent removal of the lock by deflating the tire. Then, install the spacer and lock assembly as shown.

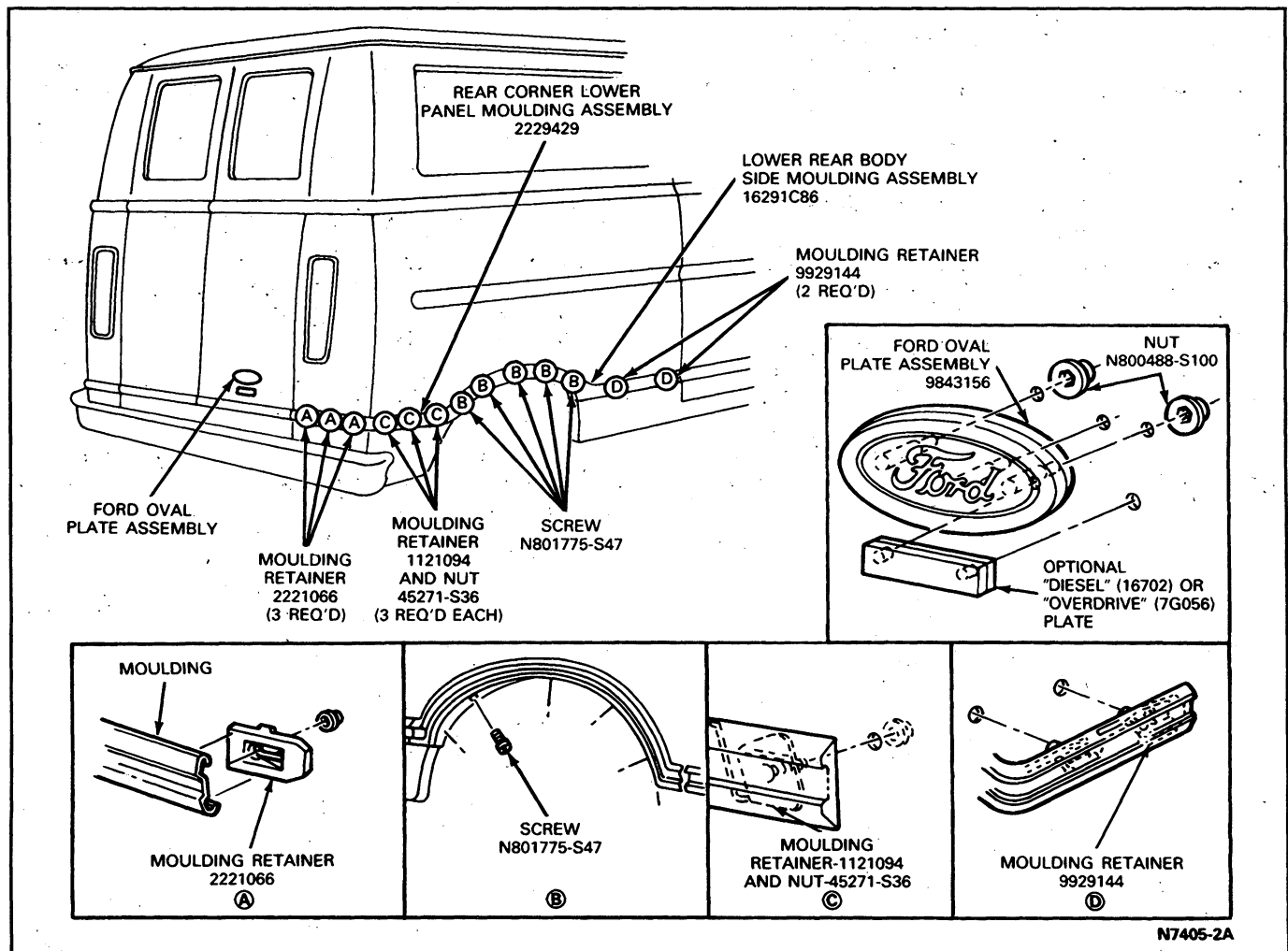


FIG. 5 Exterior Side and Rear Mouldings

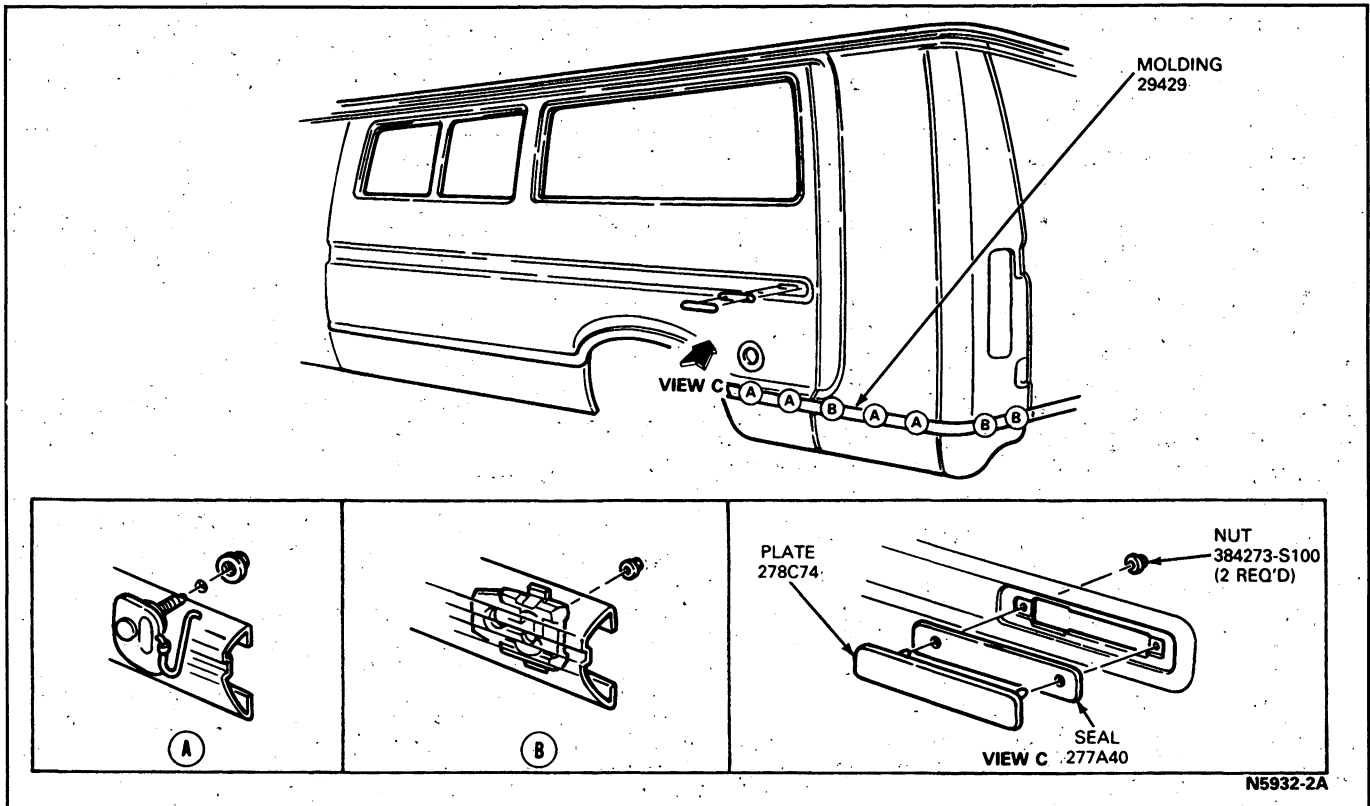


FIG. 6 Rear Corner Moulding—Super Van

**Outside Mounting****E-150—E-150****Removal and Installation**

The outside-mounted spare tire is equipped with a tire cover.

To remove, grasp the edge of the cover behind the top of the tire. Slide the cover rearward over the top of the tire, then downward.

To install, position the cover with the drainage eyelet at the bottom, over the edge of the tire. Slide the cover upward, wrapping it around the edge of the tire until the cover is completely fitted.

**NOTE:** The spare tire cover is designed to fit snugly around the tire. When properly installed, the cover seam will be centered on the face of the tire.

To remove the tire from the carrier, follow the instructions below.

1. Remove the padlock (Fig. 15).
2. Remove the retaining nut assembly.

**NOTE:** If the retaining nut is very tight, insert the "chisel point" of the lug wrench in one of the slots in either end of the retaining nut and turn the nut counterclockwise.

3. Remove the retaining disc, then slide the tire outward and lift off of the carrier.

When installing the spare tire, be sure to tighten the retaining nut securely before installing the lock. This will help prevent spare tire vibration or noise.



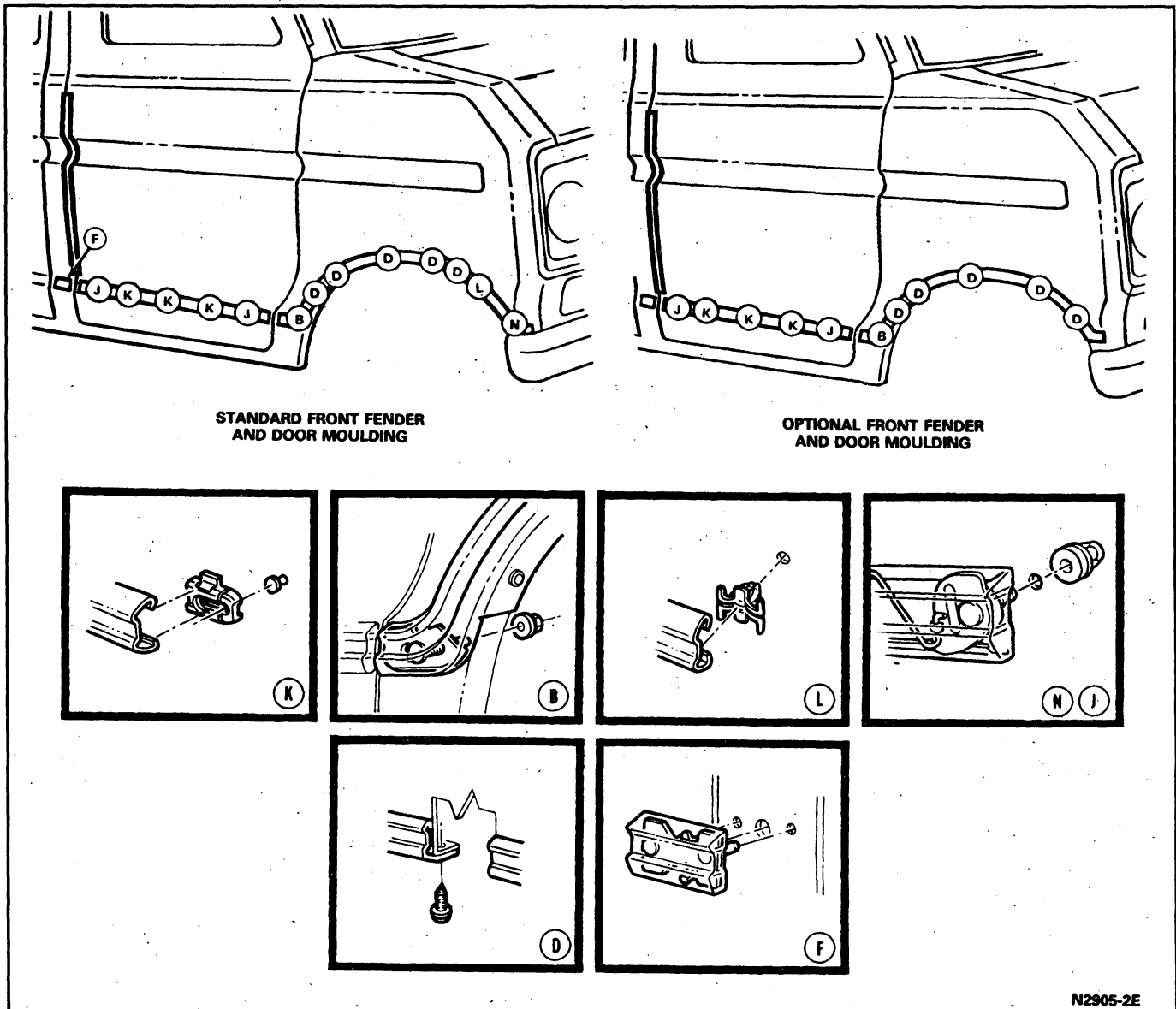


FIG. 7 Exterior Front Fender and Door Mouldings

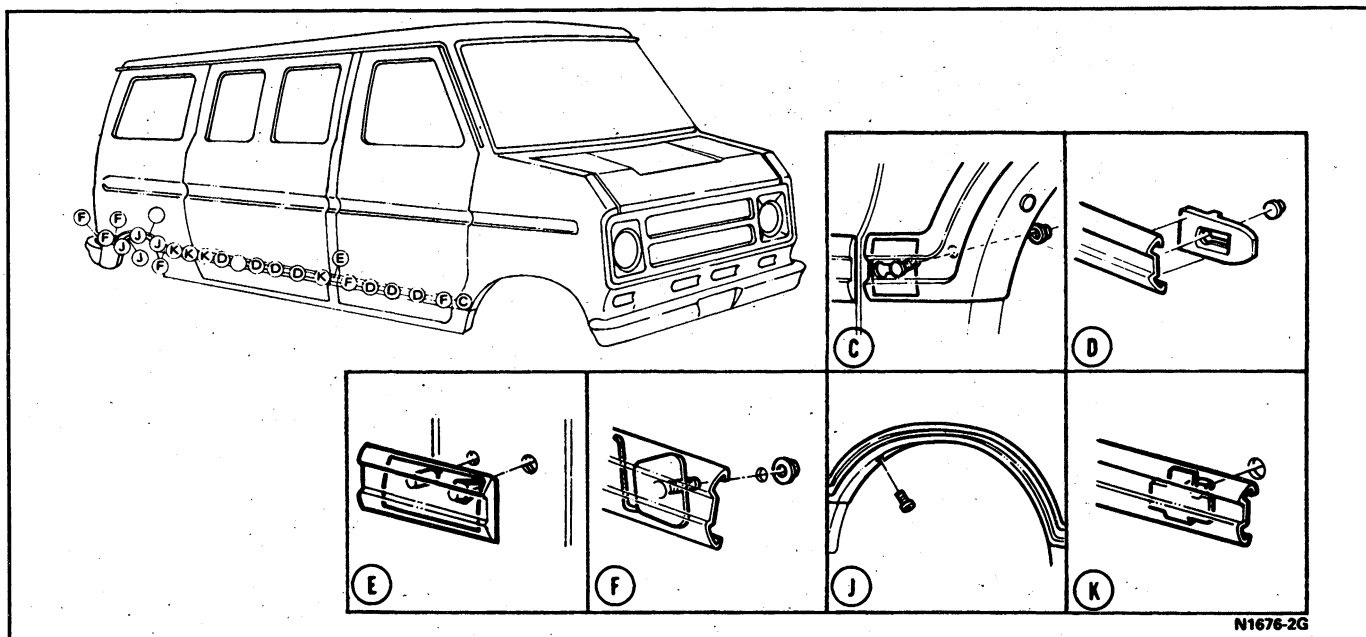


FIG. 8 Exterior Side Mouldings

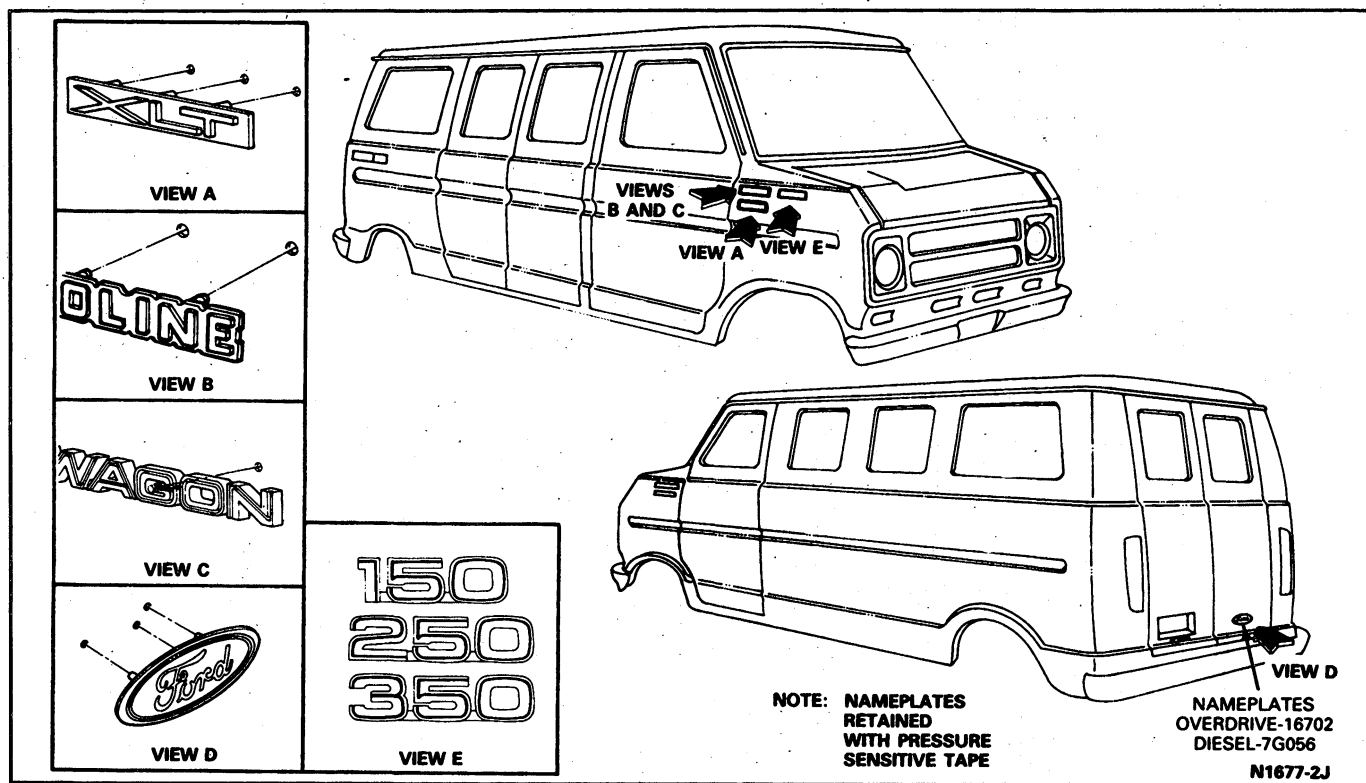


FIG. 9 Exterior Ornamentation



**FIG. 10 Body Mounts—Vans and Club Wagons**

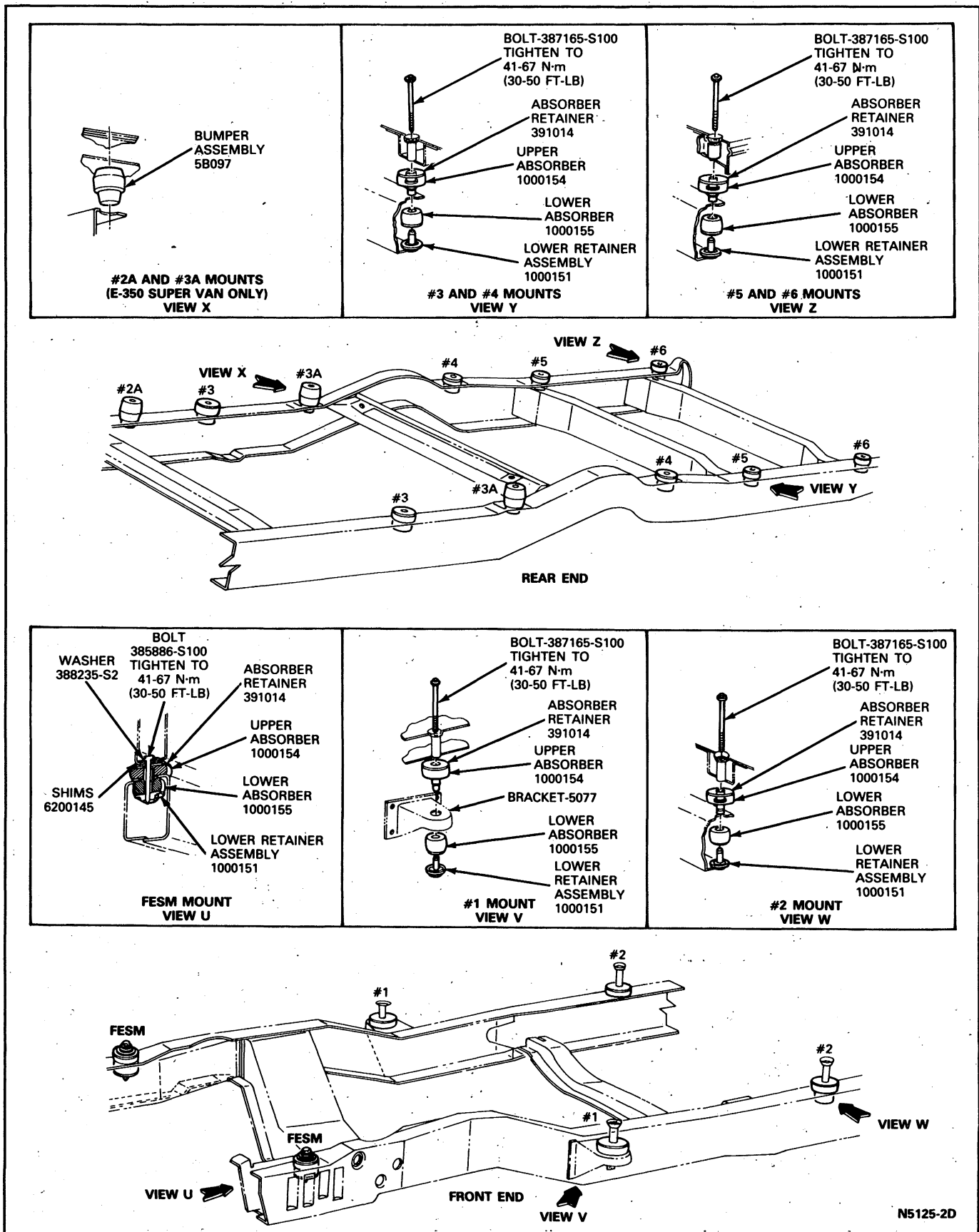


FIG. 11 Body Mounts—Supervans and Superwagons

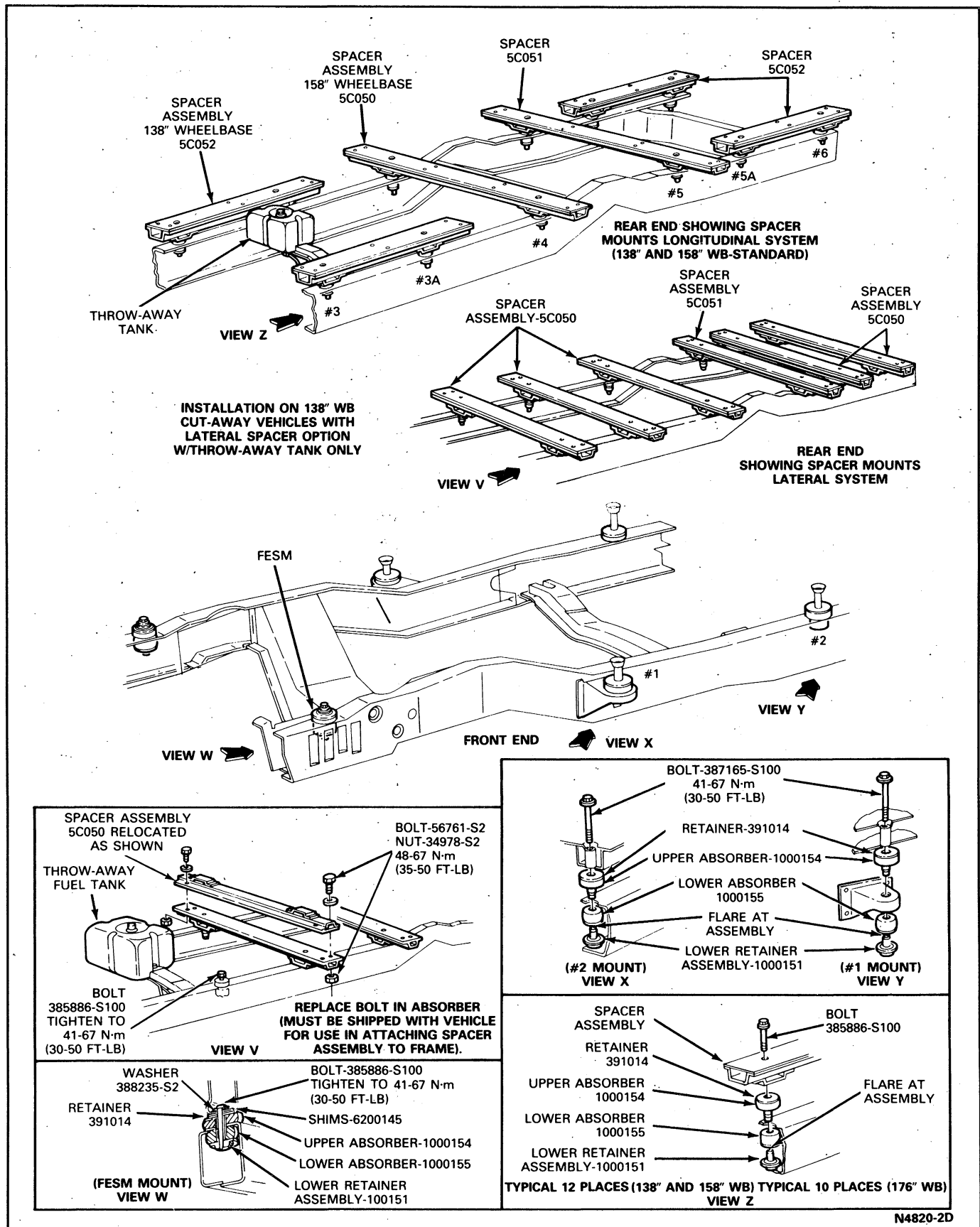
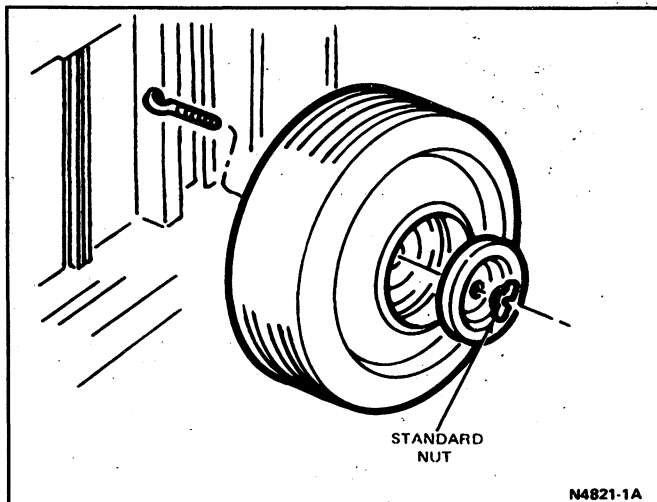
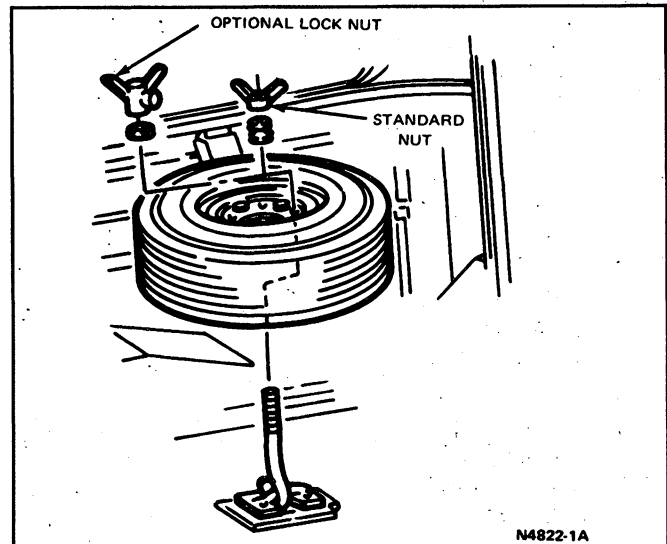


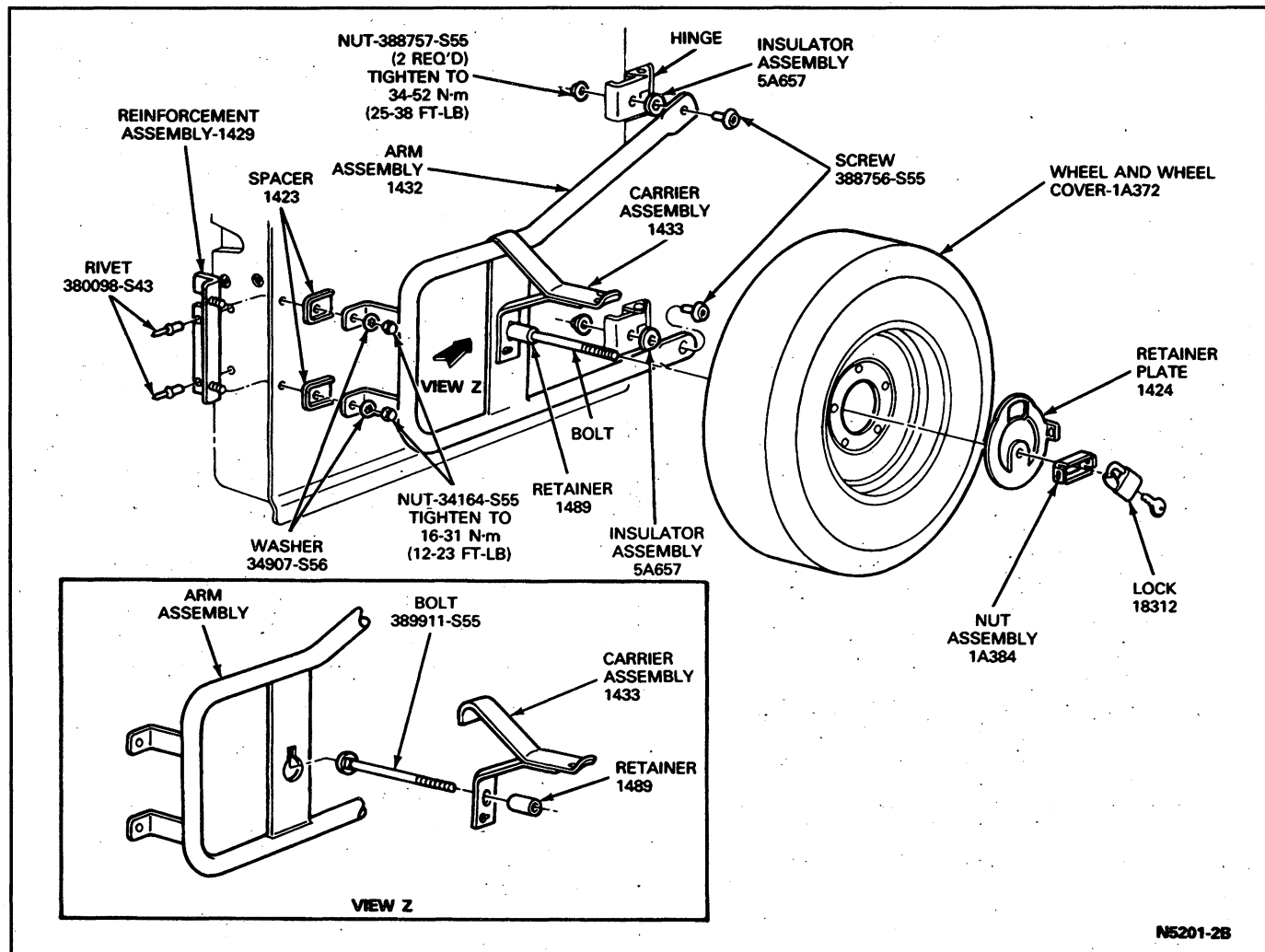
FIG. 12 E-350 Body Mounts and Spacers—Cutaway



**FIG. 13 Side-Mounted Sparewheel Stowage All Vans and 5, 7, 8, and 11-Passenger Club Wagons, Except with Seat/Bed Option**



**FIG. 14 Floor-Mounted Sparewheel Stowage  
Passenger Club Wagon, Club Wagon with  
Optional Seat/Bed and 15- Passenger Super  
Wagon Only**



**FIG. 15 E-150—Optional Outside Mounting**

## INTRODUCTION

Most threaded fasteners are covered by specifications that define required mechanical properties, such as tensile strength, yield strength, proof load and hardness. These specifications are carefully considered in initial selection of fasteners for a given application. To assure continued satisfactory vehicle performance, replacement fasteners used should be of the correct strength, as well as the correct nominal diameter, thread pitch, length, and finish.

Most original equipment fasteners (English system or Metric) are identified with markings or numbers indicating the strength of the fastener. These markings are described in the pages that follow. Attention to these markings is important in assuring that the proper replacement fasteners are used.

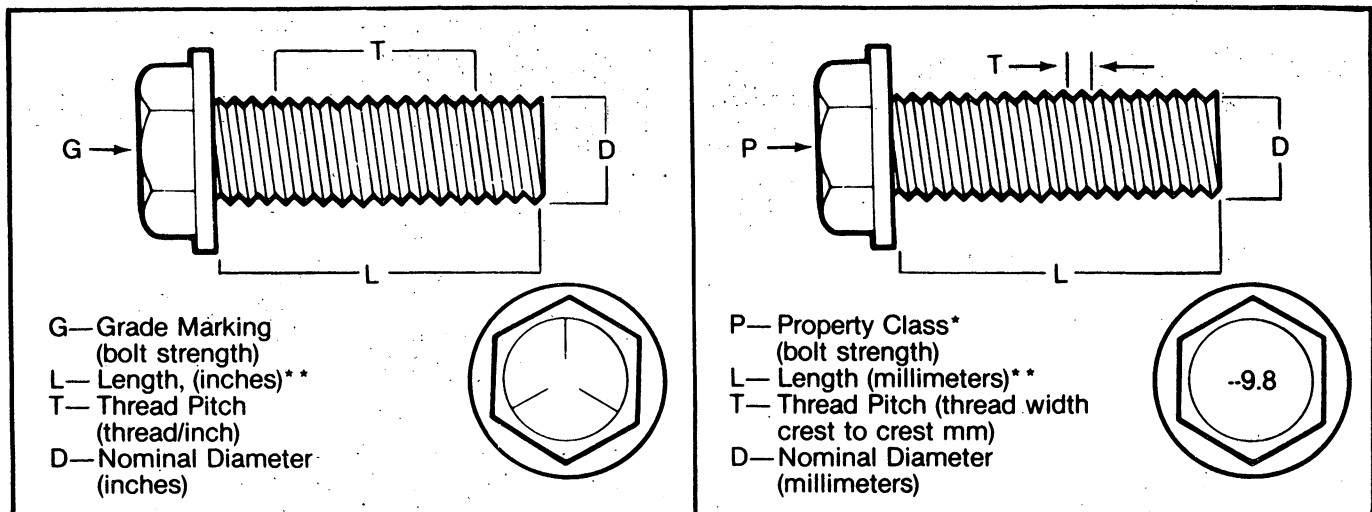
Further, some metric fasteners, especially nuts, are colored blue. This metric blue identification is in most cases a temporary aid for production start-up, and color will generally revert to normal black or bright after start-up.

English system and metric system fasteners are available through your Ford Parts and Service operation.

## NOMENCLATURE FOR BOLTS

### (ENGLISH) INCH SYSTEM Bolt, 1/2-13x1

### METRIC SYSTEM Bolt M12-1.75x25

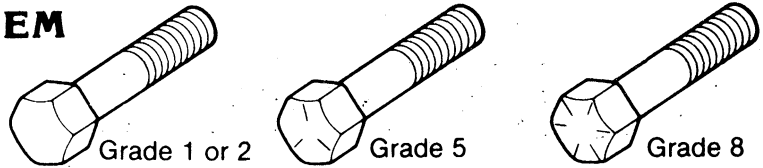


\*The property class is an Arabic numeral distinguishable from the slash SAE English grade system.

\*\*The length of all bolts is measured from the underside of the head to the end.

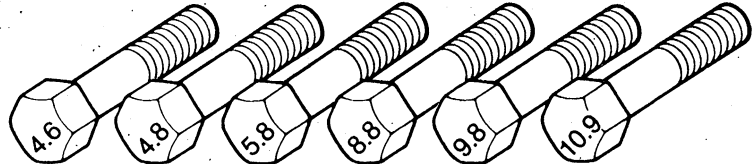
## BOLT STRENGTH IDENTIFICATION

### (ENGLISH) INCH SYSTEM



English (Inch) bolts—Identification marks correspond to bolt strength—increasing number of slashes represent increasing strength.

### METRIC SYSTEM



Metric bolts—Identification class numbers correspond to bolt strength—increasing numbers represent increasing strength. Common metric fastener bolt strength property are 9.8 and 10.9 with the class identification embossed on the bolt head.

## HEX NUT STRENGTH IDENTIFICATION

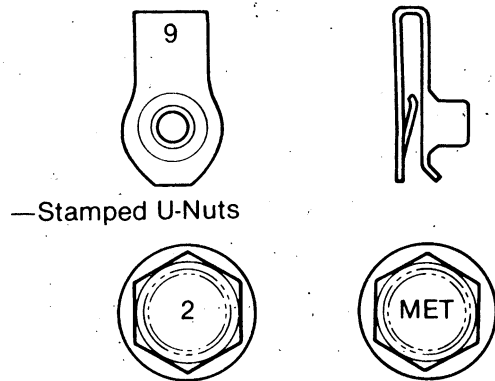
### (ENGLISH) INCH SYSTEM

### METRIC SYSTEM

Grade	Hex Nut Grade 5	Hex Nut Grade 8	Class	Hex Nut Property Class 9	Hex Nut Property Class 10
Identification			Identification		
	3 Dots	6 Dots		Arabic 9	Arabic 10
Increasing dots represent increasing strength.			May also have blue finish or paint daub on hex flat. Increasing numbers represent increasing strength.		

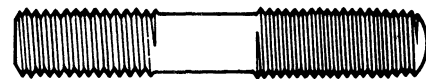
## OTHER TYPES OF PARTS

Metric identification schemes vary by type of part, most often a variation of that used of bolts and nuts. Note that many types of English and metric fasteners carry no special identification if they are otherwise unique.



—Stamped U-Nuts

—Tapping, thread forming and certain other case hardened screws



CLASS 10.9



CLASS 9.8



CLASS 8.8

—Studs, Large studs may carry the property class number. Smaller studs use a geometric code on the end.



## ENGLISH METRIC CONVERSION

Description	Multiply	By	For Metric Equivalent
ACCELERATION	Foot/sec <sup>2</sup>	0.304 8	metre/sec <sup>2</sup> (m/s <sup>2</sup> )
	Inch/sec <sup>2</sup>	0.025 4	metre/sec <sup>2</sup>
TORQUE	Pound-inch	0.112 98	newton-metres (N·m)
	Pound-foot	1.355 8	newton-metres
POWER	horsepower	0.746	kilowatts (kw)
PRESSURE or STRESS	inches of water	0.2488	kilopascals (kPa)
	pounds/sq. in.	6.895	kilopascals (kPa)
	pounds/sq. in.	1	bar
ENERGY or WORK	BTU	1 055.	joules (J)
	foot-pound	1.355 8	joules (J)
	kilowatt-hour	3 600 000. or $3.6 \times 10^6$	joules (J = one W's)
LIGHT	foot candle	10.76	lumens/metre <sup>2</sup> (lm/m <sup>2</sup> )
FUEL PERFORMANCE	miles/gal	0.425 1	kilometres/litre (km/l)
	gal/mile	2.352 7	litres/kilometre (l/km)
VELOCITY	miles/hour	1.609 3	kilometres/hr. (km/h)
LENGTH	inch	25.4	millimetres (mm)
	foot	0.304 8	metres (m)
	yard	0.914 4	metres (m)
	mile	1.609	kilometres (km)
AREA	inch <sup>2</sup>	645.2	millimetres <sup>2</sup> (mm <sup>2</sup> )
		6.45	centimetres <sup>2</sup> (cm <sup>2</sup> )
	foot <sup>2</sup>	0.092 9	metres <sup>2</sup> (m <sup>2</sup> )
	yard <sup>2</sup>	0.836 1	metres <sup>2</sup>
VOLUME	inch <sup>3</sup>	16 387.	mm <sup>3</sup>
	inch <sup>3</sup>	16.387	cm <sup>3</sup>
	quart	0.016 4	litres (l)
	quart	0.946 4	litres
	gallon	3.785 4	litres
	yard <sup>3</sup>	0.764 6	metres <sup>3</sup> (m <sup>3</sup> )
MASS	pound	0.453 6	kilograms (kg)
	ton	907.18	kilograms (kg)
	ton	0.90718	tonne
FORCE	kilogram	9.807	newtons (N)
	ounce	0.278 0	newtons
	pound	4.448	newtons
TEMPERATURE	degree fahrenheit	0.556 (°F -32)	degree Celsius (°C)

## DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal Inch	Metric mm
1/64	.015625	.397
1/32	.03125	.794
3/64	.046875	1.191
1/16	.0625	1.588
5/64	.078125	1.984
3/32	.09375	2.381
7/64	.109375	2.778
1/8	.125	3.175
9/64	.140625	3.572
5/32	.15625	3.969
11/64	.171875	4.366
3/16	.1875	4.763
13/64	.203125	5.159
7/32	.21875	5.556
15/64	.234375	5.953
1/4	.250	6.35
17/64	.265625	6.747
9/32	.28125	7.144
19/64	.296875	7.54
5/16	.3125	7.938
21/64	.328125	8.334
11/32	.34375	8.731
23/64	.359375	9.128
3/8	.375	9.525
25/64	.390625	9.922
13/32	.40625	10.319
27/64	.421875	10.716
7/16	.4375	11.113
29/64	.453125	11.509
15/32	.46875	11.906
31/64	.484375	12.303
1/2	.500	12.7

Fractions	Decimal Inch	Metric mm
33/64	.515625	13.097
17/32	.53125	13.494
35/64	.546875	13.891
9/16	.5625	14.288
37/64	.578125	14.684
19/32	.59375	15.081
39/64	.609375	15.478
5/8	.625	15.875
41/64	.640625	16.272
21/32	.65625	16.669
43/64	.671875	17.066
11/16	.6875	17.463
45/64	.703125	17.859
23/32	.71875	18.256
47/64	.734375	18.653
3/4	.750	19.05
49/64	.765625	19.447
25/32	.78125	19.844
51/64	.796875	20.241
13/16	.8125	20.638
53/64	.828125	21.034
27/32	.84375	21.431
55/64	.859375	21.828
7/8	.875	22.225
57/64	.890625	22.622
29/32	.90625	23.019
59/64	.921875	23.416
15/16	.9375	23.813
61/64	.953125	24.209
31/32	.96875	24.606
63/64	.984375	25.003
1	1.00	25.4

## TORQUE CONVERSION

NEWTON METRES (N·m)	POUND-FEET (LB·FT)
1	0.7376
2	1.5
3	2.2
4	3.0
5	3.7
6	4.4
7	5.2
8	5.9
9	6.6
10	7.4
15	11.1
20	14.8
25	18.4
30	22.1
35	25.8
40	29.5
50	36.9
60	44.3
70	51.6
80	59.0
90	66.4
100	73.8
110	81.1
120	88.5
130	95.9
140	103.3
150	110.6
160	118.0
170	125.4
180	132.8
190	140.1
200	147.5
225	166.0
250	184.4

POUND-FEET (LB·FT)	NEWTON METRES (N·m)
1	1.356
2	2.7
3	4.0
4	5.4
5	6.8
6	8.1
7	9.5
8	10.8
9	12.2
10	13.6
15	20.3
20	27.1
25	33.9
30	40.7
35	47.5
40	54.2
45	61.0
50	67.8
55	74.6
60	81.4
65	88.1
70	94.9
75	101.7
80	108.5
90	122.0
100	135.6
110	149.1
120	162.7
130	176.3
140	189.8
150	203.4
160	216.9
170	230.5
180	244.0

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- **Were any subjects not covered?**

**If yes: Please describe.** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- **Were any sections confusing or hard to understand?**

**If yes: Manual** \_\_\_\_\_ **Volume** \_\_\_\_\_ **Page** \_\_\_\_\_

**Please comment:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- **Could you quickly find what you needed? Yes** \_\_\_\_\_ **No** \_\_\_\_\_

**Suggestions:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- **Tell us who you are:**

**Name** \_\_\_\_\_

**Address** \_\_\_\_\_

**Position** \_\_\_\_\_ **Company** \_\_\_\_\_

**It is most helpful if you would enclose a copy of each page, marked with your suggestions.**

4/23/86